

# NASA News

National Aeronautics and  
Space Administration

Ames Research Center  
Moffett Field, California 94035  
AC 415 965-5091

per Peter Waller 415/965-5091 7 Mar. 1980  
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## PIONEER PROJECT OFFICE CLOSING AFTER MANY ACCOMPLISHMENTS

After 16 years of developing and flying spacecraft to various planets and in orbit around the Sun, the Pioneer Project Office at NASA's Ames Research Center is closing down.

Responsibility for operation of the 7 Pioneers still working in interplanetary space is being transferred to the Space Missions branch at Ames. The move is a result of the termination of the Pioneer series of spacecraft.

The Pioneers still operating are: the four Pioneers 6 to 9, which currently form a network of solar weather stations around the Sun; and Pioneer 10 and Pioneer Saturn, both headed out of the solar system after the first two flights to Jupiter, and the first flight to Saturn. Pioneer Venus continues to orbit the cloud-shrouded planet photographing cloud circulation, mapping Venus' surface, and taking a range of other data.

Pioneer Venus was the last development responsibility of the Pioneer Office. This was a sophisticated mission involving six spacecraft--four atmosphere probes, a probe carrier and an orbiter. A total of 28 scientific instruments were carried by the six Venus spacecraft. The atmosphere probe missions were successfully completed in December 1978, and the Orbiter continues to return major data from Venus, such as the first detailed terrain maps.

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2/28/80

Pioneer 10 made the first close up pictures of Jupiter, sounded the giant planet's intense radiation belts, determined that it was an entirely liquid planet, and made other important discoveries. The spacecraft then used the energy of Jupiter's orbital motion to begin the first trip out of the solar system. It carries a message for any intelligent species who might find it.

Pioneer Saturn also flew to Jupiter, making the only pictures so far of Jupiter's polar regions. It skimmed close to the planet's cloud tops, flying through the most intense zone of its searing radiation belts.

It then crossed the solar system, reaching Saturn last September, after a billion mile trip from Jupiter. It took the first close up pictures of the ringed planet, measured its magnetic and radiation environments and the characteristics of its interior; and it found a new moon and a new ring.

The 12 Pioneer missions have all been very highly productive scientifically, and the spacecraft have accomplished several dozen "firsts" in a variety of areas. The Project Office and its staff members have received many awards, including two of international reputation.

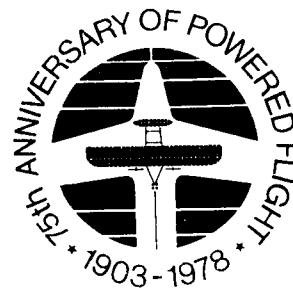
"Charlie Hall" (Pioneer Project Manager) "and all who have participated in the program deserve our congratulations and a hearty well done," said Ames Director C. A. Syverston in a staff memo on the subject. "I want to thank them for being such a great credit to Ames," he added.

NASA Headquarters has just awarded a large number of NASA medals and other recognition to individuals and teams who have made Pioneer go. Hall was given the Distinguished Service Medal, NASA's highest award. He is retiring after 38 years of service with the agency.

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Evvie Rasmussen 415/965-5091

Release No. 80-7

## NASA TESTING 55-TO-65-YEAR-OLDS FOR SPACE FLIGHT STRESSES

Can humans older than 55 withstand the physiological stress of weightlessness riding aboard NASA's Space Shuttle?

To answer that question, the space agency for the first time is subjecting males aged 55 to 65 to prolonged bedrest, a way to simulate the weightless environment of space flight.

The test subjects are the oldest NASA has subjected to simulated weightlessness. Four previous studies at NASA's Ames Research Center, Mountain View, California, tested males and females aged 35 to 45 and 45 to 55. Women aged 55 to 65 will be tested later this year, completing the planned series of six studies designed to set baseline medical criteria for space-flight participation.

Forty-six males, aged 55 to 65, reported for the first briefing at Ames in early February. Of the 44 who reported for physical examination, 25 were found fit enough to participate in preliminary testing -- 10 of these were in the 60-65 age group. Twenty were selected to report for orientation on March 24, with the other five serving as alternates.

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April 4, 1980

The preliminary orientation and testing serves a dual purpose: it gives Dr. Harold Sandler, Ames project scientist, an opportunity to see how subjects perform and it also allows the subjects an opportunity to decide whether they want to participate.

Two sets of four subjects will be selected next Monday, April 7. Four will be admitted April 10 to Ames' Human Research Facility for nine days of controlled observations, 10 days of bedrest and five days of recovery and post-bedrest tests of the cardiovascular system. Another four subjects will be admitted April 13 for the same sequence of events.

Sandler has 11 co-investigators, nine associated with the Ames center, one at NASA's Johnson Space Center in Houston, one at Stanford University and one at the New Jersey Medical School.

The Ames Human Research Facility is managed by Dee O'Hara, R.N.

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Feb 19

Evvie Rasmussen 415-965-5091

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IMMEDIATE

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## NASA TECHNOLOGY BRINGS RECYCLED WATER CLOSER TO HOME

In an experimental wastewater treatment plant in Palo Alto, Calif., NASA has been working with the Santa Clara Valley Water District, the Environmental Protection Agency and the California Department of Water Resources using a system of automatic water quality monitoring that is quick, efficient and requires almost no human intervention.

Although the recycled water is not piped into homes, it is clean enough to be returned to the San Francisco Bay without harm to sea life. And, according to NASA project manager Ken Nishioka, the water may be "cleaner than tap water," but studies still must be done to determine the long-term effects, if any, of drinking it.

Automated water quality monitoring, defined as the ability to obtain desired water quality data without human intervention, offers continuous unattended operation of sensors which analyze a flowing sample stream. Samples are continuously collected and analyzed, and immediate results are available.

(more)

February 19, 1981

Requirements by the EPA for potable water specifications can be met by currently used methods and equipment. But when a large number of samples must be collected and analyzed, manpower requirements make these manual operations expensive.

Samples often are sent to distant labs for periodic testing, but they may change composition in transit (for example, volatiles may be substantially lower). Results of these analyses may not be known for several weeks.

NASA's automated system consists of a computer and a number of instruments designed to sense the presence of bacteria. Operational instruments include: an automated twin-column gas chromatograph, developed at NASA's Ames Research Center, based on the Viking lander chromatograph which was designed to detect life on Mars; an automated coliform sensor, developed by Boeing Co., Houston, and an automated biomass detector, built by Boeing based on research at NASA's Goddard Space Flight Center, Greenbelt, Md. A viral detector, developed at Ames, is being evaluated, and technology for a heavy metal sensor is being developed. These instruments will be added at a later date.

The project has three goals: to demonstrate the feasibility of automated water quality monitoring; to identify key water quality sensors; and to evaluate the cost effectiveness of water treatment.

(more)

February 19, 1981

Twelve water quality characteristics are measured by the system, including ammonia, chlorides, coliform, halocarbons, sodium, temperatures, pH, and hardness.

The project began in 1974 at NASA's Johnson Space Center, Houston, when NASA, the Department of Housing and Urban Development and the EPA set out to plan the total use of waste products from a large apartment complex or small city. Glass and metals were to be recycled, paper waste burned for heat and hot water, and wastewater was to be purified and reused.

A panel of experts determined the biological, chemical and physical qualities which would have to be measured for purification of wastewater.

Design and assembly of the automated water quality monitoring system to meet these parameters was completed at the Johnson Space Center. The system was tested in Houston's Southwest Wastewater Treatment Facility.

When Santa Clara Valley Water District officials heard about the system, they asked to have it transferred to the experimental water reclamation plant in Palo Alto.

When the unit was installed in Palo Alto in 1977, management was transferred to Ames Research Center.

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February 19, 1981

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## NASA SCIENTIST USES BIOFEEDBACK TO STOP MOTION SICKNESS

Learning to prevent motion sickness is like learning to play the piano, says a NASA scientist who has studied responses to motion in more than 100 subjects.

If your brain has something akin to the sound of a wrong note to tell it when your body is "off-key," you can learn to control physiological responses to motion, such as nausea and dizziness, according to Dr. Patricia Cowings, psychophysiologicalist at NASA's Ames Research Center.

Cowings believes she might have a cure for "space sickness," the motion sickness which occurs in the weightless environment of spaceflight and has afflicted about half of all astronauts. She may get a chance to test her theories aboard the Space Shuttle in the 1980s.

Working in Ames' Biomedical Research Division, Cowings and her research associate William Toscano have taught about 50 volunteers how to suppress illness when subjected to an ever-faster spinning chair. Another 60 subjects were studied without the training.

Eighty-five percent of the trained subjects improved their ability to withstand motion. Sixty-five percent were able to completely suppress illness symptoms, regardless of the increase in revolutions per minute. The other 20 percent were able to withstand a significant increase in rpms before becoming sick. For the 15 percent who failed, the six hours of training

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May 6, 1980

for the study may not have been enough, Cowings believes. No one in the untrained control groups showed any significant improvement with time.

The trained subjects monitored bodily functions such as respiration and heart rate, learning to recognize when their bodies were operating best. In addition to the biofeedback, subjects were taught mental exercises which would elicit optimal responses, to speed up the learning process. They then applied the technique while in the rotating chair.

Advantages of biofeedback over conventional treatments for motion sickness include an absence of side effects, such as the sleepiness common with drug therapy. Biofeedback training transfers from one type of motion sickness to another; other treatments often do not. Biofeedback succeeds because it treats the symptoms common to all forms of motion sickness, Cowings said.

The next step for Cowings is to test her theories in space. She has designed a study which she hopes will be on one of the first two life science Spacelab missions aboard the Space Shuttle, scheduled for 1983 and 1985. Her study may prevent motion sickness in the two astronauts while allowing Cowings to study their physiological responses to weightlessness.

Cowings' experiment is one of the studies tentatively selected for the first two life science flights. Specific experiments will be chosen two years before the flights.

If her study gets the go-ahead, Cowings will train the two crew members as she's trained her other subjects over the past seven years. At launch, Cowings said, the astronauts will be wired to a tiny, eight-channel cassette tape recorder which will monitor the subjects' physiological responses and provide a feedback display to each subject.

Once daily, the crew members will have to consciously check to be sure their responses are optimum. But if a subject starts to feel sick, he or she must immediately apply the biofeedback training for a maximum of 30 minutes.

If the astronaut becomes sick, he or she will push a button to mark the tape, which Cowings later will study to find out what led up to the illness.

Physically fit persons frequently are susceptible to motion sickness -- in fact, young athletes often are the persons most sensitive to motion. An athlete's body must produce strong reactions to perform athletic feats, Cowings explained, but in ordinary stress situations, the response is inappropriate.

Cowings' first subjects were men. She has begun to study women and so far has found no significant sex differences. Having studied subjects aged 18 to 45, Cowings has found that the older the subjects, the less susceptible they are to motion sickness.

For the Spacelab experiment, Cowings' co-investigators are Dr. Neal Miller of Rockefeller University, Dr. Ernest Hilgard of Stanford University, Dr. Joe Kamiya of University of California, San Francisco, Dr. Joseph Sharp, deputy director of Life Sciences at NASA-Ames, and William Toscano, UCSF doctoral candidate who has worked with Cowings on the experiments for the past five years.

The life sciences Spacelab experiments are managed jointly by NASA's Johnson Space Center and NASA's Ames Research Center. Spacelab is being built by the European Space Agency (ESA) and is managed for the United States by NASA's Marshall Space Flight Center.

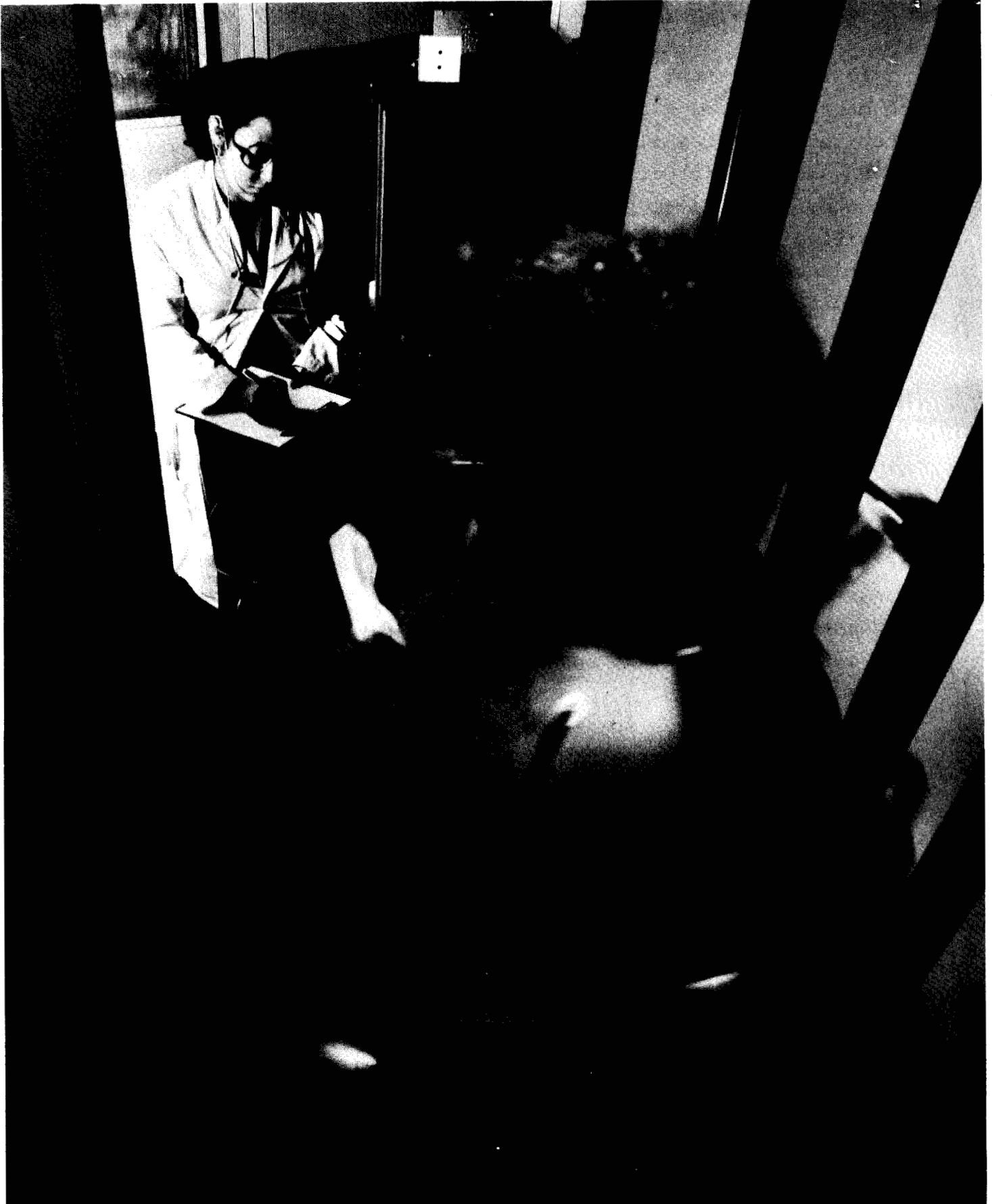
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NOTE TO EDITORS:

The photos pictured on the next two pages are available from the Ames' Public Affairs Office, (408) 965-5091.

May 6, 1980

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A80-0382-29 (B/W) and AC80-0382-13 (color) -- Dr. Patricia Cowings monitors the physiological responses of William Toscano, her research associate, while he spins in the rotating chair which is used to induce motion sickness in human volunteers.



A80-0382-27 (B/W) and AC80-0382-9 (color) - Ames' lab assistant Leah Schafer, of Kalamazoo College, Kalamazoo, Mich., is strapped into a vertical motion simulator by Dr. Patricia Cowings. The simulator is one of the devices used by Cowings to induce motion sickness in human volunteers.

# NASA News

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11/17/80

For Release:

May 28, 1980

Peter Waller 415/965-5091

Release No. 80-47

## NAMES PROPOSED FOR NEWLY-IDENTIFIED FEATURES ON VENUS

Based on data returned by Pioneer Venus, scientists have identified major features on the cloud-shrouded planet, and are working with an international nomenclature group to name them after mythical goddesses.

The orbiting spacecraft now has mapped a belt of terrain extending completely around the planet. It finished the job on May 18, 1980. The spacecraft radar mapper instrument measures terrain from 75° North latitude to 63° South latitude. Pioneer has mapped 93% of Venus' total surface.

Investigators have identified two huge continent-like features on Venus. One centered at 65° North, is the size of Australia and contains mountains as high as Everest -- the loftiest peak on Earth. The other, centered about 5° South of the equator, has somewhat lower terrain and is half as large as Africa.

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The data show a variety of other features, including deep rift valleys, rolling plains, high plateaus and mountains.

Pioneer Venus has returned a huge volume of geographical information about Venus, and planetwide contour maps have been developed by the Massachusetts Institute of Technology, Cambridge, and the U.S. Geological Survey, Astrogeologic Studies Branch in Flagstaff, Ariz. The mapping process involved converting continuous altitude measurements and radar images along the Pioneer orbital track to detailed contour plots and relief maps of the planet. This process requires error removal, orbit sorting and other types of data reduction.

Scientists have proposed that the northern highland mass be named Ishtar Terra, for Ishtar, the Babylonian goddess of love and war. Aphrodite Terra has been proposed as a name for the equatorial upland mass, after the Greek goddess of love -- known to the Romans as Venus.

Ishtar was one of the Babylonian (Assyrian) trinity of major gods. Known as "the lady of battles", she often was depicted riding on a lion, weapon in hand. She was daughter of the Moon and sister of the Sun. Aphrodite (Venus), for whom the planet is named, is a major figure in the Greek pantheon.

The names for the two major features were proposed by the Principal Scientific Investigators of the radar mapping team:

Drs. Gordon Pettingill of the Massachusetts Institute of Technology and Harold Mazursky of the U.S. Geological Survey. They met with the Working Group on Planetary Nomenclature of the International Astronomical Union. The group has decided that nomenclature policy for major features on Venus should reflect mythical goddesses from various cultures. Minor features will be named for other mythical female figures, and still smaller circular features will be named for famous women who are no longer living.

The astronomical union's working group has members from the United States, the Soviet Union and Canada.

Pioneer Venus has been circling Venus since December 1978, and is operating well. Another spacecraft -- consisting of a carrier bus and four attached probes -- arrived at Venus in the same month and penetrated the Venusian atmosphere.

Together, data from the Orbiter and four probes are providing the most comprehensive information ever of the phenomenon that most visibly sets Venus apart from its "sister planet" Earth -- its perpetual cloud cover and dense hot atmosphere.

The Pioneer project is managed by NASA's Ames Research Center, Mountain View, CA. The Pioneer Venus spacecraft were built by Hughes Aircraft Co., El Segundo, CA.

NOTE:

Photographs to illustrate this news release can be

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obtained by writing or phoning:

NASA Ames Research Center  
Public Affairs 204-12  
Moffett Field, CA 94035

Telephone: (415)965-5091

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May 28, 1980

# NASA News

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Peter Waller (415)965-5091

For Release:  
7:30 A.M. PDT  
Wednesday, May 28, 1980

RELEASE NO: 80-48

## FACT SHEET

Note: Though in Fact Sheet format, all material herein is released for the first time.

### THE SURFACE OF VENUS FROM PIONEER\*

Based on extensive radar data returned by NASA's Pioneer Venus spacecraft, scientists for the first time have mapped nearly the entire cloud-shrouded planet, and have identified huge continent-sized features -- including mountains as high as Everest and deep rift valleys.

Pioneer Venus has now mapped about 83 percent of the planet's surface, and by month's end will have covered 93 percent. Prior to Pioneer, less than one percent of Venus' topography had been measured by ground-based radar.

Venus' surface has never been seen because of the clouds which permanently cover the planet.

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\* The information contained in this Fact Sheet is based on a paper prepared by Dr. Harold Masursky of the U. S. Geological Survey, Flagstaff, Ariz., Dr. G. B. Pettengill of Massachusetts Institute of Technology and others, for a Fall issue of the Journal of Geophysical Research. Drs. Masursky and Pettengill are members of the Pioneer Venus radar altimeter team.

Pioneer data suggest that Venus' terrain and geology have both strong similarities to and major differences from those of any known planet. According to Dr. Harold Masursky, Venus' surface is gently rolling, with local dramatic highs like the North American continent. However, not counting Earth's oceans, Venus' range of elevations is somewhat greater than Earth's, ranging from 2.9 kilometers (9500 feet) below the average radius of Venus' spherical surface to 10.8 km (35,400 feet) above that level.

Venus terrain data were provided by the Pioneer Orbiter spacecraft, which will measure topography on the planet for several more years. The Pioneer Project is managed by NASA's Ames Research Center, Mountain View, CA. The spacecraft were built by Hughes Aircraft Co. The radar-mapper instrument was provided by Massachusetts Institute of Technology, and maps by the U. S. Geological Survey, Flagstaff, AZ.

#### Venus' Topography

Pioneer's radar-mapper measures Venus surface deviations in topography from 75 degrees North latitude to 63 degrees South latitude. This covers 93 percent of the planet's surface, missing relatively small circular regions at each pole.

Because of temporary instrument failure, a mapping gap exists along 30 degrees longitude. Pioneer is currently mapping this area. Typical "footprint" size for altimetry measurements of topography is 25 by 50 km, on a grid with spacing of 100 km.

Sixty percent of Venus' surface is relatively flat, rolling plains, varying in height by only about 1000 meters (300 ft.) between high and low points. This huge, planet-encompassing plain lies at a 6050-km radius from the center of the planet. (This 6050-km radius describes a reference sphere, much as sea level does on Earth.)

About 16 percent of Venus' surface lies below the 6050-km mean radius. Such low-lying regions are far more common on Earth (they are the ocean basins) than on Venus, occupying nearly two-thirds of Earth's surface compared to the one-sixth of Venus.

Most of the remaining 24 percent are only a few thousand feet higher than the plain. Only eight percent of the planet is "true highlands," ranging in height to maximum altitudes 10.6 km (35,400 ft.) above Venus' rolling plains. These true highlands may resemble similar areas on Earth. They may be made of very light rock, and hence "float" much higher than other features.

The largest of the highland regions, Terra Aphrodite,\* is half as large as Africa. The smaller highland region, Terra Ishtar, is the size of the continental United States. Both Ishtar and Aphrodite are rough, apparently fractured and faulted. Two other notable highland areas are Beta Regio, site of what seem to be two giant shield-shaped volcanoes, and Alpha Regio, a region of rough, probably geologically old terrain.

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\* Venusian features have been tentatively named by scientists, pending action by the Working Group on Planetary Nomenclature of the International Astronomical Union.

### Venus Crust and Crustal Movements

Although not as thick as those of Mars and the Moon, it now appears that Venus' crust is thicker than Earth's -- so thick that it has choked off most crustal movement or plate tectonics. The lower layer of this crust apparently consists of heavier basalt-type rocks and wraps the entire planet. On top of this is a layer of light, granitic-type continental rock. (Russia's Venera 8 found the radioactivity of rocks in one area of Venus' plains to be like that of granite.) This ancient layer of lighter rocks may form a single huge planet-girdling continent, covering about 84 percent of Venus' total surface. Perched on top of this giant Venusian continent are the smaller but still continent-sized highland regions.

Venus' crust apparently compresses one huge tectonic plate, compared with Earth's six major plates and several minor ones. Due to continuous formation of new plate material, Earth's plates constantly expand and grind together. Plates which adjoin are forced over and under each other -- as with the collision of the Indian and Asian plates, pushing up the Himalayas.

On Venus, only about 16 percent of the surface consists of low-lying basins comparable to Earth's ocean basins. There is no evidence of features similar to Earth's mid-ocean ridges, where molten basalt wells up to form new crust. On Earth, old crust is carried back into the hot interior by the submergence of one tectonic plate beneath its adjoining plate. Most of Earth's plate boundaries are at the edges of continents, but some are in mid-ocean.

By evolving much more crust than Earth and producing a thick top layer of buoyant material, Venus has squelched plate tectonics says Dr. William Kaula of the University of California, Los Angeles.

### Ancient Terrain and Highlands

There appear to be abundant primordial impact craters like those on Mars and the Moon scattered over the surface of Venus. These craters have diameters above 75 km (45 mi.), large enough for Pioneer to observe. Most of Venus' surface (and hence crust) appears to be ancient terrain. Atmospheric heating, water loss and crust formation apparently took place in the first 1-2 billion years of the planet's history.

Venus' two continent-sized highland areas, Ishtar and Aphrodite, may be remnants of the last plate tectonic collisional zones, before crust formation choked off tectonics completely. Alternatively, they may result from local lifting forces (like those that created California's Sierra Nevada range).

### Ishtar Terra

The highest and most dramatic continent-sized highland region on Venus is the Northern highland or Ishtar Terra. It is a high plateau, carrying several mountain ranges. It is about the size of Australia or the continental United States.

The western part of Ishtar (named for the Assyrian goddess of love and war) appears to be a smooth plateau. It is called Lakshmi Planum and is about 3300 m (10,000 ft.) above sea level. Lakshmi is bounded on the west and north by mountains ranging upward from

2300 to 3300 m (7000 to 10,000 ft.) above the plateau, and 5700 to 7000 m (17,000 to 20,000 ft.) above "sea level." The western mountains have been tentatively named Akna Montes and the northern range, Freyja Montes. The Ishtar plateau is about as high as the Tibetan plateau, but twice as large. The central area of the plateau is smooth in the radar images and may be covered with relatively young lavas. The huge escarpments around the plateau's edge are quite steep.

#### Maxwell Montes

The highest point yet found on Venus, a mountain massif higher than Everest, has been named Maxwell Montes. This huge area of uplifted terrain occupies the entire east end of the Ishtar Terra highlands. Its highest point is 11,800 m (35,300 ft.) above "sea level" and 9000 m (27,000 ft.) above the adjoining Lakshmi plain. The highest parts of the massif run northwest-southeast with lower projections extending both east and west. Observations from both Earth and Pioneer suggest that the mountain region itself is the roughest part of the planet -- jumbled terrain, changing abruptly from the smooth plateau west of it. The brightness of this feature indicates that the steep slopes of this Mount Everest of Venus are covered with rocks larger than 10 cm (2.5 in.). On the east flank of Maxwell, Pioneer data show a circular 100-km (60 mi.) diameter dark feature more than 1000 m (3000 ft.) deep. This may be a volcanic crater. East of Maxwell, extending for 100 degrees of longitude, is a complex topography of ridges and troughs, including many closed basins.

### Aphrodite Terra

The largest continent-sized highland region on Venus has been tentatively named Aphrodite. It is as large as the northern half of Africa, and consists of two mountainous areas separated by a somewhat lower region. Situated almost on Venus' equator, Aphrodite Terra runs almost directly east and west for 9600 km (6000 mi.).

Unlike Ishtar, a relatively level plateau carrying high mountains, the Aphrodite highland region rises to various heights above the mean planet surface. The western mountainous area rises 8000 m (23,000 ft.) above the surrounding terrain, 9000 m (26,000 ft.) above Venus mean surface. The eastern mountains of Aphrodite rise 3300 m (10,000 ft.) above the surrounding terrain, 4300 m (13,000 ft.) above the mean surface. Like Ishtar, the terrain of these Aphrodite mountains appears to be quite rough. Because Aphrodite does not appear to contain uplifted plateaus or volcanic mountains, Aphrodite may be older and more degraded than Ishtar Terra.

### Beta Regio

Centered at about 30 degrees north latitude on Venus is Beta Regio, apparently consisting of two huge shield-shaped volcanoes, larger than the Hawaii-Midway chain. Beta Regio appears to be situated on a fault line running north and south, from 40 degrees north latitude to 50 degrees south latitude. This long fault zone connects several other highland features, which may be volcanic, south of Beta Regio. The two huge, adjoining mountains (smooth on the surface and shaped like the very wide-based Hawaiian volcanoes) cover a north-south distance of about 2100 km (1300 mi.). Aside from

their appearance, rocks making up the twin Beta mountains appear to be basaltic and hence very likely of volcanic origin. (The Soviet spacecraft Veneras 9 and 10 landed just east of Beta and found the rocks there to have radioactive element concentrations similar to basalts.)

The two shield-shaped mountains making up the Beta region have been named Theia Mons (the northerly mountain) and the Rhea Mons (the southerly mountain). Both rise out of Venus' great planet-spanning plains, and both are about 4000 m (13,000 ft.) above the plain, i.e., above Venus mean surface.

#### Alpha Regio

The fourth notable highland feature on Venus is Alpha Regio, a rough region lying about 1800 m (6000 ft.) above the Venusian great plain. Alpha Regio is about 25 degrees south of the equator and 6400 km (4000 mi.) west of Aphrodite. Radar imaging shows that it has extremely rough terrain with parallel fractures through the whole feature. It may combine old and new geologic forms and resembles the basin and range structure of the western United States.

#### Venus' Great Plain

As noted, a relatively flat, rolling plain covers 60 percent of Venus' surface. Radar imaging shows many circular, dark features with bright central spots on this rolling plain.

These apparent craters with diameters of 400 to 600 km (250 to 320 mi.) characteristically have depths of only 200 to 700 m (650 to 2300 ft.). The bright, central areas could be the central peaks, typical of impact craters.

The very small depths and the very large diameters of these apparent craters, compared with the Moon and Mars, can be explained by "surface rebound" like that found on Jupiter's planet-sized moons. (The apparent wide-spread cratering suggests that Venus's heavily-cratered ancient crust is preserved over much of the planet.)

### Lowlands

The largest low area so far found on Venus is centered west of Ishtar at 70 degrees north. At its deepest point, this great basin is about 3000 m (9,000 ft.) below Venus' great plain region. This low area, like others on the planet, is smooth, and lacks large crater forms. Like Earth's ocean basins it may be relatively young geologically and filled in by basaltic lava flows. It is about the same size as the North Atlantic ocean basin.

The lowest point on the planet appears to be in the rift valley just east of Aphrodite, slightly lower than the northern hemisphere basin at about 2.9 km (9500 ft.) below Venus' mean surface. This trench is deeper than the Dead Sea rift, but only one-fifth the depth of the Marianas trench in the western Pacific. It is roughly the same depth as Vallis Marineris, the great canyon on Mars. While Venus apparently has no plate tectonics, this rift valley and another parallel to it, both in the region east of Aphrodite, seem comparable to tectonic rifts on Earth. Here, new rock material wells up out of the molten interior.

In general, the jumbled region east of Aphrodite is characterized by high ridges and deep valleys. There is a similar region east of Ishtar.

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IMMEDIATE

## SIMPLE ENZYME-LIKE CATALYST DISCOVERED

### SUPPORTS NEW ORIGIN OF LIFE THEORY

A scientist at NASA's Ames Research Center has proposed a new way of thinking about the origin of life on Earth. He proposes that simple self-replicating chemical systems rather than complex ones could have served as the precursors of living cells in the origin of life more than 3.5 billion years ago. The ideas are being published in the current issue of the Journal of Molecular Evolution.

Scientists have believed for some time that natural energy (lightning, sunlight, heat) interacted with the atmosphere, soils, and oceans of the primordial Earth. This continuous interaction, perhaps over millions of years, is thought to have caused chemical reactions that produced ever-more-complex molecules from simple precursors such as gases in the atmosphere. This is the hypothesis of chemical evolution. Eventually, this process is believed to have culminated in the evolution of complex chemical systems that could reproduce themselves, leading to the first living cell.

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December 18, 1980

However, due to the statistical improbability of combining these molecules into a single chemical entity, it has been hard to see how enough of the right building blocks could have been assembled by chance in the right place, even over a billion years, in order to produce a complex living cell. The entire process becomes much easier to envision if the necessary components are simple and few in number.

The new theory, developed by Dr. David White, Assistant Professor at the University of Santa Clara and a Research Associate in the Extraterrestrial Research Division at Ames, supposes that the first chemical systems, which were "alive" only in the sense that they could reproduce themselves, may have been far simpler than previously thought. Such self-replicating systems, he suggests, could have appeared very early in the chemical evolutionary process and consisted of amazingly simple components. The question raised by the theory is whether some combination of these simple molecules would have the necessary properties to reproduce themselves. One necessary property has now been demonstrated for the first time.

The Ames-Santa Clara researchers have shown that under simulated primitive Earth conditions, a remarkably simple, short amino acid chain can produce chains of another amino acid, glycine, up to six links long; and it can form links up to 50 times for each catalyst molecule. The simple catalytic molecule, histidyl-histidine, functioned like an inefficient primitive enzyme. Enzymes are biological proteins which repeatedly catalyze a reaction, and histidyl-histidine is the first simple molecule to demonstrate this vital

function. The reactions took place on dried clay surfaces which might be comparable to the shores of the primitive oceans.

Demonstrations that a molecule made of just two amino acids (histidyl-histidine) can carry out the linking reaction up to 50 times and make up to six-link chains of the amino acid glycine is interesting in itself. However, it appears to be important because it fits Dr. White's theory of simple, self-reproducing systems. Researchers began looking for a suitable proto-enzyme catalyst because the theory suggested it. They found one right away. Dr. White believes there are a number of other simple short amino acid chain catalysts.

The fact that a short amino acid chain can repeatedly catalyze the formation of chains of another acid is an exciting result, but it is not enough for the origin of a self-reproducing system of molecules since nucleic acids have to be involved as well in the role of "memory" molecules to carry genetic heritage from one generation to the next.

Computer modelling, based on known properties of molecules, showed that in theory a self-reproducing system could be amazingly simple. In principle, the simplest possible system (called an autogen by Dr. White) would consist of two proto-enzymes (two short amino acid chains). It assumes that the building block molecules of amino acids and nucleic acids were already present in the primordial environment, an assumption which has gained some support from laboratory simulation experiments.

In this theoretical system: 1) One short amino acid chain would catalyze the synthesis of both of the short

nucleic acid chains. 2) The other amino acid chain would catalyze the formation of the two amino acid chains (itself and the other proto-enzyme). 3) The two short nucleic acid chains would tell the amino acid chain catalysts how to make all four products of the system. The four-component system would theoretically make many more such systems from the stock of building blocks assumed to have existed in the primordial environment. Just how the nucleic acids would specify the exact amino acid chains remains to be demonstrated, which is a problem for all such theories. The advantage of the new theory is that the accuracy of the specification process need not be very great.

"We may find that a four-component system is too simple," comments Dr. White. "We may have to look for more complexity to get realistic self-reproduction. However, the success of these first experiments suggest that simple catalytic processes may be common in nature. Besides, we have not been able to formulate any other way to get the whole thing started."

The researchers now plan an array of experiments looking for other simple catalysts and for nucleic acid patterners, using the most commonly found biological building blocks. The eventual goal is to discover whether self-reproducing molecules can organize themselves in laboratory experiments. One of the advantages of the theory is that it provides guidelines for the design of future experiments to test its predictions.

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December 18, 1980

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For Release:

Release No. 80-62

IMMEDIATE

## SAINT HELENS VOLCANO AIDS STUDIES OF CLIMATE

Scientists are studying the plumes emitted from Mount Saint Helens to find out how volcanic eruptions may change the Earth's weather and climate.

Saint Helens eruption data collected for the NASA Ames Research Center Aerosol Climate Effects (ACE) program constitute the most complete set of observations ever made of volcanic aerosols in the stratosphere. (Aerosols are fine particles, either solid or liquid, suspended in gas -- smoke, fog and mist are common aerosols.)

Stratospheric measurements are important because aerosols remain in the stratosphere for months, sometimes years -- much longer than they remain in the lower atmosphere.

The NASA-Ames U-2 flew ACE stratospheric sampling missions of the Saint Helens plume on May 19, 22, 27 and June 14 and 17. Seven experiments aboard the U-2 were designed to observe the atmosphere after the eruptions of May 18, May 25 and June 12.

Preliminary data analysis indicates the volcanic plumes contained a mixture of solid ash particles and sulfuric

(more...)

July 18, 1980

## Climate Studies

2-2-2

acid, with proportions varying in different samples.

The amount of sulfuric acid found in the stratosphere was several hundred times greater than the amount found prior to the eruptions. Ash particles as large as 30 microns (about .001 inch), with a composition similar to ash found on the ground near the volcano, were found on the first flight. On later flights, the largest particles found were about 3 microns (.0001 inch).

Large increases in gaseous sulfur dioxide also were detected. Such sulfur-containing gases are sources for additional sulfuric acid particles, which are produced by the action of sunlight on the gas. The sulfur dioxide levels on the first flight were 10 to 1,000 times ambient levels. On the second flight, sulfur dioxide levels were 100 times normal.

Also on the second flight, water vapor abundance within the plume was at least 10 times its normal amount, indicating that a large amount of volcanic water was injected into the stratosphere.

The ACE program began 1½ years ago to assess the climatic effect of aerosols in the Earth's atmosphere, according to Ames' Dr. James Pollack, chief scientist for ACE.

Before the May 18 eruption, the ACE scientists had been studying aerosols using U-2 research aircraft observations in conjunction with NASA satellite measurements of global aerosol number densities. A July 1979 ACE flight over Alaska provided baseline levels for comparison to post-eruption atmospheric conditions.

(more...)

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## Climate Studies

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The first ACE flight of Saint Helens, 21½ hours after the May 18 eruption, was over northern Washington and parts of Idaho, Montana and Wyoming. The second sampling mission was flown over Boise, Id., and Great Falls, Mont.

After the May 25 eruption, a third flight was made along the Canadian coast between Vancouver Island and the Queen Charlotte Islands. After the third eruption June 12, the U-2 made a June 14 flight over Montana and a June 17 flight over Denver, Colo., and Laramie, Wyo.

The pilots could see the plume on the first four flights. On the first flight, the plume spread from above 58,000 feet down to the tropopause at 42,000 feet. The cloud was so dense that the pilot had to fly on instruments for a portion of the 2½ hours of sampling.

On the second flight, the visible plume was found in a thin layer at 66,000 feet, about 1,000 feet thick. On the third flight, the plume was a thin layer at 55,000 feet. On the fourth flight, plume debris from the June 12 eruption was visible between 41,000 and 44,000 feet, with an older, thinner layer lying at 62,000 feet.

Over California, the stratosphere at first was relatively unaffected by the eruption. After debris from the May 18 eruption had circled the Earth, it was observed over California between May 29 and June 3 at 13 km (8 mi) altitude. Regions above that altitude were clear. The material over California was similar to other samples -- ash particles mixed with heavy amounts of sulfuric acid.

(more...)

July 18, 1980

## Climate Studies

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Below is a list of experiments and investigators:

<u>Instruments</u>	<u>Principal Investigator</u>	<u>Flights</u>
Multiple Filter Sampler	Allen L. Lazrus National Center for Atmospheric Research William Zoller University of Maryland	1-5
Cryo Sampler	Edward C.Y. Inn NASA Ames Research Center	1-5
Aerosol Particle Sampler	Neil H. Farlow NASA Ames Research Center Robert J. Charlson University of Washington	1-5
Frost Point Hygrometer	David G. Murcray University of Denver	2-5
Quartz Crystal Microbalance	M. Patrick McCormick NASA Langley Research Center	2,3,5
INS Winds, Pressure & Temp.	Stanley Scott NASA Ames Research Center	3-5
H <sub>2</sub> O Infrared Radiometer	Peter Kuhn National Oceanic and Atmospheric Administration	4,5

In addition to the U-2 sampling missions, NASA Ames sent the U-2 aircraft to photograph Mount Saint Helens on June 19. For one month after the May 18 eruption, Ames personnel watched weather maps for skies clear enough to allow the U-2 to photograph the volcanic damage from a height of 65,000 feet.

The photographic mission was carried out at the request of the Washington State Office of Emergency Services under the Ames Western Regional Applications Program.

The U-2 photography has given Washington state agencies the first comprehensive coverage of the damaged area. The U-2 camera has a 24-inch focal length lens, capable of resolving

(more...)

July 18, 1980

## Climate Studies

5-5-5

features two to five feet in diameter. Each nine by 18 inch frame represents four by eight miles on the Earth below.

The U-2 data will be used in conjunction with the data acquired by the NASA Stratospheric Aerosol and Gas Experiment (SAGE) satellite for studies aimed at assessing the potential climatic consequences of the Mount Saint Helens eruptions.

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July 18, 1980

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Release No. 80-68

## NASA TO TEST MEN FOR FLUID LOSS DURING WEIGHTLESSNESS

Eight men aged 35 to 50 will participate in a study of weightlessness this month to help NASA find out why spaceflight causes humans to dehydrate.

The NASA Ames Research Center study is being conducted by Dr. Joan Vernikos-Danellis, a pharmacologist with the Ames Biomedical Research Division.

Prolonged horizontal bedrest is an effective way to simulate the weightless condition of spaceflight. The head-down position, where the head is lowered six degrees from the horizontal, has long been used by Soviet scientists to simulate weightlessness.

Vernikos-Danellis will use the head-down method for this study because she believes it is the rush of blood to the head during the first exposure to weightlessness that triggers the body mechanism which eliminates fluids and salts. Such measurements have not been obtainable during spaceflight because of the heavy demands on astronauts in the first part of a mission.

The eight volunteers for this study will be admitted

-more-

August 11, 1980

## Fluid Loss/Weightlessness

2-2-2

to the Ames Human Research Facility Aug. 14 for seven days of controlled activities, followed by seven days of bedrest. The men will be discharged Sept. 2, two days after returning to ambulatory status.

When first admitted, the men will start a diet to regulate salt and potassium levels in the blood. After four days of the diet, sodium and potassium levels, blood pressure, pulse rate and echocardiogram will be measured daily.

In addition, stress hormones and hormones which regulate body fluids will be measured eight times during the first 24 hours of bedrest and during the first 24 hours post-bedrest.

During the bedrest period, a salt solution will be injected to determine whether added salt will suppress the hormones which cause the body to lose fluids. Other tests include measurements of the kidney's ability to function during bedrest and of blood volume.

Vernikos-Danellis has five co-investigators for this study: Dr. L.C. Keil of Ames, Dr. James Thomas of Wayne State University Medical School in Detroit, Dr. Danielle Goldwater of Ames, Dr. Mary Dallman of the University of California Medical School in San Francisco, and Victor Convertino of Stanford University Medical School.

The Ames Biomedical Research Division is directed by Dr. Harold Sandler. The Human Research Facility is managed by Dee O'Hara, R.N.

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August 11, 1980

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*Aug 25*

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**IMMEDIATE**

## NASA-ASEE SUMMER STUDY EXPLORES

### TECHNOLOGY FOR "INTELLIGENT" SYSTEMS

An orbiting space factory, a self-directed deep space exploration robot, a fully automated Earth resources and environment monitor, and even a lunar base that could grow through self-replication of many of its elements have been examined in a space technology assessment workshop, looking at the next 25 years.

Robotics, artificial intelligence, automation and remotely operated systems are vital to the future of these missions. The enormous benefits of such capabilities at affordable cost have prompted this joint NASA/American Society of Engineering Education summer study at the University of Santa Clara in California.

The program participants include 18 professors of engineering mathematics and sciences, some 15 NASA engineers and scientists, and a number from interested industrial organizations. The group is drawing on the work of research institutions such as Stanford University, MIT and SRI International as developers of computer-based "intelligence" capability.

The ten-week workshop will be completed on Friday, August 29, when an oral report will be presented at the University and reports are submitted for publication.

The workshop was structured to select and define a set of exciting and challenging space missions that would identify critical technology needs for future research and development. As such they are representative of possible future missions rather than specific proposals.

Feasibility analysis has concentrated primarily on four areas:

- 1) A highly versatile "intelligent" satellite information system for most types of Earth survey. Previous systems have suffered from the fact that they record everything they "see", producing huge masses of data.

The proposed information system would do substantial amounts of selection and interpretation of the data incoming from its sensors, to provide results tailored to the specific needs of the requester.

In one approach, the system would possess its own "world model", stored in a ten trillion bit data memory. This would provide reference knowledge of the region of the requested observation.

The satellite would report exceptions to this reference model, such as changes in crop conditions, discarding such well known phenomena as icebergs, lakes, and other landmarks. This would result in a major reduction in the amount of data that must be transmitted and analyzed. The world model would be updated to reflect latest dynamic conditions.

- 2) A second concept is a Deep Space Exploration system to provide reconnaissance, exploration, and intensive surface study of planetary bodies.

Specifically, the group is looking at a mission to Saturn's planet-sized satellite, Titan. (Titan has an atmosphere and is bigger than

the planet Mercury.) The proposed, self-directed system would combine the functions of several previously separate missions: orbiter, atmospheric probe, and mobile surface exploration vehicle.

The vehicle would observe such a relatively unknown environment, and modify its "knowledge model" and exploration techniques, based on what it had observed. Major improvements in remote sensors, as well as advanced computer "intelligence", <sup>surface</sup> are required to select/regions for more intensive investigations.

Such self-directed systems could be used to explore distant bodies within the solar system, the outer planets and their satellites, comets and asteroids. It is also the type of system required for the eventual exploration of planetary systems of other stars, where flight and communication times of many years preclude manned involvement and interaction.

3) A third area is a facility for use of non-terrestrial materials (from asteroids and moons of Earth and other planets). This would be a permanent, automated Earth-orbiting facility initially using the space environment for unique processing of Earth-supplied raw materials. It would progressively make greater use of non-terrestrial materials. The group is identifying processing and manufacturing techniques well adapted to the space environment. Basic "starter facilities" are being identified, to be capable of producing a wide range of products and other tools to expand the facility capability.

4) Finally, the workshop defined, as an ultimate challenge for advanced automation, a factory on the moon which would use lunar materials and could replicate itself. One of its first products

would be another lunar factory, or factory segment. Such an automated, reprogrammable, self-replicating factory has been of theoretical interest, for a number of years, as a way of rapidly expanding utilization of space resources. The workshop has developed "proof-of-concept" designs and surveyed the types of logical organization for such a factory, and the requirements for an Earth-based demonstration of the concept.

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August 25, 1980

# NASA News

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*Aug 26*

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IMMEDIATE

## NOTE TO EDITORS:

The future role of robotic devices, advanced automation, and artificial intelligence in the exploration of space has been the focus of a NASA sponsored space technology assessment study this summer at the University of Santa Clara, California. The study covered such things as an orbiting space factory, a deep space exploration robot, an automated Earth monitoring system, and a lunar base which could grow through self replication. The project was carried out by 18 university professors, 15 NASA engineers and scientists, and a number of industry people.

Results of the research will be reported at a briefing in the University's Mayer Theatre on Friday, August 29, from 9 a.m. to noon.

Representatives of the press are invited to attend the morning briefing. A summary of the research results will be given by project representatives at 12:00 noon. Members of the research team will be available for questions after the briefing.

For television, one or more robotic devices and color visuals are expected to be available.

Mayer Theatre is located on the University of Santa Clara campus at the corner of Franklin St. and Lafayette St. For parking, please enter the main gate of the university on The Alameda, between Franklin and Santa Clara Sts., and tell the guard you are attending the conference in Mayer Theatre.

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August 26, 1980

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## NASA SELECTS TWO FIRMS FOR DESIGN STUDIES FOR SUPERCOMPUTER

NASA has selected two corporations to do system design studies for its Numerical Aerodynamic Simulator, a specialized supercomputer, which will assist in developing and testing of new aircraft designs and other flight vehicles, and do general research in such fluid flow areas as meteorology, gas dynamics and computational chemistry.

Value of each of the two parallel, firm fixed-price study contracts is \$350,000.

The studies are expected to result in a new data processor which may be 40 times faster than existing supercomputers, with a high speed memory 60 times larger than the current generation of supercomputers.

NASA's Ames Research Center, Mountain View, CA, has selected for negotiation for the parallel design studies: Burroughs Corp., Federal and Special Systems Group, Paoli, Pa.; and Control Data Corp., Special Programs Division, Arden Hills, Minn.

The new specialized computer uses fluid flow equations to calculate continuously three-dimensional air flows at thousands of points simultaneously. This means the computer can calculate

-more-

the actual air flow, and can simulate conditions of wind tunnel testing at far less expense than actual model tests in wind tunnels.

Computer simulation will complement wind tunnel tests by substantially reducing the amount of testing required for a particular new aircraft or flight vehicle design, and produce better designs.

Plans call for the proposed new computer to perform one billion operations per second using a data base of 40 million words. With a data base of 200 million words, the new processor would handle three quarters of a billion operations per second. The device is proposed to handle 100 simultaneous users. The system would be equipped with a two-billion-computer-word on-line storage system with two second access and a 100-billion computer word off-line memory with 10 minutes access.

The design work will be performed at the contractors' facilities.

The parallel design definition studies are for 40 weeks, to be followed by selection of one of the two firms for a detailed design, fabrication, test and integration phase. Parallel preliminary design and feasibility phases were completed by Burroughs and Control Data during 1977-1979, and work on the system has been underway at Ames since 1975. The design and fabrication phase is planned to be complete in five years, with the new data processor to be operational in October 1986.

The project is part of NASA's aeronautics research and technology program. Ames Research Center has project responsibility for the Numerical Aerodynamic Simulator.

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NASA PICKS HUGHES FOR NEGOTIATION  
FOR GALILEO PROBE CARRIER SPACECRAFT

NASA has selected the Space and Communications Group of Hughes Aircraft Co. for negotiation of a contract for the Galileo Probe Carrier Spacecraft. Estimated value of the contract is about \$40 million. The Carrier will transport the Galileo Probe to Jupiter, where the Probe will separate and enter Jupiter's atmosphere. It will measure the atmosphere for an hour down to a level where atmospheric pressure is ten times Earth's surface pressure.

The work on the Probe Carrier will be performed at Hughes Space and Communications Group facilities in El Segundo, CA.

The Galileo Probe Carrier and Probe are to be launched by NASA's Space Shuttle in March 1984 and will reach the planet 1200 days after Shuttle launch, in July 1987. The Probe will separate from the Carrier 100 days before planet arrival and will enter Jupiter's thick atmosphere at a speed of 160,000 kph (100,000 mph), slowing in a few seconds

- more -

to a few hundred miles per hour. At this point, a parachute will open and the Probe will slowly descend. In this critical maneuver, deceleration forces on the Probe will be 400 times the force of gravity.

Jupiter's atmosphere is believed to be made of the original material from which the stars formed, and scientists are greatly interested in this. Further, a vertical profile of atmosphere composition and movements will allow understanding of Jupiter's weather, currently a mystery. Understanding Jupiter's weather may provide insights into Earth weather mechanisms.

At the planet, the Galileo Probe Carrier will aim and release the Probe toward Jupiter. It will receive scientific data from the Probe during its entry and descent into Jupiter's atmosphere, and will transmit the data back to receiving stations on Earth.

The spin-stabilized Galileo Probe Carrier features a fixed parabolic dish antenna, aligned parallel to its spin axis to receive Probe data. It will also have a despun antenna with adjustable elevation, on its opposite end, for communications with Earth. The Probe will be mounted directly to the Carrier and the Carrier spin axis will be aligned by Sun and star sights. Communications with Earth will be maintained throughout the mission, with Probe data returned both in real time and with later playback from tape recorders. The Carrier will be nuclear powered by two radioisotope thermoelectric generator units because solar energy is too weak for power as far out as Jupiter.

Probe and Probe Carrier development is by NASA's Ames Research Center, Mountain View, CA.

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## TEST OF GALILEO

### JUPITER ATMOSPHERE PROBE PARACHUTE

NASA will flight test the parachute system for the Galileo Jupiter atmosphere probe on 9 December 1980 at the Naval Weapons Center Test Range, China Lake, CA. This will be the third and last test of the Galileo Probe parachute system at the China Lake Facility. Previous tests showed the need for improvements, which have been made in the parachute for the coming test.

Once the current test program is completed the parachute design will be ready for delivery to the Probe. There will be one last chance to witness the opening of the chutes during a drop test in early 1982. A fully equipped Probe will be taken aloft to 100,000 feet altitude over the White Sands Missile Range in New Mexico and released from an Air Force Geophysics Laboratory balloon. Once released the Probe will descend into the test range in a flight similar to the Jovian descent with parachute and hardware staging.

At the planet, the parachute system will slow the descent of the probe in Jupiter's turbulent atmosphere for

- more -

an hour while it makes the first measurements of the atmosphere of an outer planet. During its flight through the atmosphere, the probe will travel down through Jupiter's expected ammonia, ammonia hydrosulfide and water cloud layers. It will make the first attempt to find out what elements and chemical compounds produce Jupiter's stunning colors, and shape its fantastic weather patterns. The Probe carries six instruments to directly sample Jupiter's atmosphere from the top down to the level of about 15 times Earth's atmospheric pressure, well below the water clouds. The Galileo Probe will be mounted to a Carrier Spacecraft and launched from the Space Shuttle in March, 1984. The probe will encounter the giant planet in September, 1987.

The upcoming test will consist of an aircraft drop of a cylindrical test vehicle. The purpose is to make sure of proper chute opening, and to test strength and construction of the parachute structure. The chute is a conical ribbon design made of Dacron material. The chute design is very similar to the one which performed the same job during the descent of the Pioneer Sounder Probe into Venus' dense atmosphere.

The test will be a qualification test that will overload the system by 50 per cent, with a drop from 48,400 feet at 1116 kph (693 mph), just over the speed of sound (Mach 1.05). The drop aircraft is a Navy YF-4J plane. Weight to be suspended from the NASA main parachute is 287 kg (633 lbs). Test range personnel will attempt to recover both test parachutes for inspection.

The Galileo Probe parachute system consists of a mortar explosive device to eject the pilot chute. The pilot chute

pulls out the main chute, and the main chute extracts the probe descent module from the protective module carrying the heat shield, after peak atmosphere entry heating is over. The chute slows and controls the descent of the probe.

The pilot chute is 1.12 meters (3.74 ft) in diameter, and main parachute is 3.75 meters (12.5 ft) in diameter. The test vehicle is an 18-inch diameter, 76-inch long aluminum cylinder. In addition to the test parachutes, the test vehicle carries batteries, telemetry equipment, event timers, tracking/recovery beacons, instrumentation, recovery parachute systems and two aft-facing cameras to record test parachute functioning.

Flight data radioed to the ground will sample orientation gyros, accelerometers, load-measuring devices, and event monitor circuits. When the test is complete, the test vehicle will be brought to Earth by a 22-inch controller chute, a five-foot drogue chute, and a 35-foot main chute. The impact velocity is approximately 35 fps.

Photo coverage of the test includes the back-looking cameras on-board the test vehicle, ground station cameras, and two under-wing cameras on the drop aircraft.

NASA's Ames Research Center, Mountain View, CA manages the Galileo Jupiter Probe. NASA's Jet Propulsion Laboratory, Pasadena, CA manages the over all Galileo mission.

The Hughes Aircraft Company (El Segundo, CA) is the prime contractor for the Probe System. The deceleration module is supplied by General Electric Company (Philadelphia, PA) and the parachute subsystem is manufactured by Pioneer Parachute Company (Hartford, CO).

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IMMEDIATE

## NOTE TO EDITORS:

Completion of detailed analysis of data from the Pioneer Venus Orbiter and five atmosphere probes now appears to have produced a number of new findings:

- 1) Scientists have an explanation for the planet-wide circulation of Venus' entire atmosphere.
- 2) New ultraviolet photographs from the Pioneer Orbiter, covering a two-year period, show long-term patterns of the circulation of Venus' clouds.
- 3) Further new work now seems to explain the working of Venus' greenhouse effect (which produces the planet's searing heat).
- 4) Researchers have some entirely new and significant measurements of elements making up the planet's atmosphere.

Many scientists think that understanding Venus' weather patterns will provide insights into the workings of Earth's weather.

A news briefing describing these new findings will be held at Ames on Thursday, December 4, at 10 a.m.

For television, two large color illustrations explaining Venus' atmosphere circulation have been prepared. There also will be new color pictures of the planet and models of the spacecraft.

News people planning to attend the briefing should come to the NASA gate of Moffett Field, and will be directed from there.

November 25, 1980

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IMMEDIATE

## NOTE TO EDITORS:

A workshop on the atmosphere of Saturn's big satellite, Titan, will be held at NASA's Ames Research Center on Dec. 1 & 2. Titan, a planetary body with a thick atmosphere, is larger than the planet Mercury.

The workshop will be attended by a variety of experts on Titan's atmosphere, both theoretical and observational--some 25 of them, from NASA, universities, and elsewhere. Principal subjects for discussion will be the surface temperature, pressure, and physical nature (solid or liquid) of Titan's surface. One intriguing possibility is that Titan has quantities of liquid nitrogen--possibly enough to make lakes or oceans. Much new data on Titan has just been provided by the fly by of NASA's Voyager spacecraft.

An informal briefing for news people on the findings of the workshop will be held on Wednesday morning, December 3 at 10 a.m. Those planning to attend should come to the NASA gate of Moffett Field and will be directed from there.

November 25, 1980

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IMMEDIATE

## PIONEER VENUS 1 COMPLETES TWO YEARS

### IN ORBIT. MISSION PLANNED THROUGH 1986

The Pioneer Venus Orbiter spacecraft will have completed two Earth years (the equivalent of three Venus' days) in orbit around the cloud-shrouded planet on Thursday, Dec. 4.

The spacecraft is expected to remain in Venus orbit until 1992. Current mission planning extends through 1986. In the next six years, the Pioneer Orbiter will be looking at Venus from a variety of new vantage points.

Since its arrival at Venus on December 4, 1978, Pioneer has made 730 24-hour orbits of the planet. It has returned over 1000 ultraviolet pictures of Venus's clouds, and it has mapped by radar 93 per cent of the planet's surface, revealing a terrain of mountains, high plateaus, and great plains. Pioneer has transmitted over 40 billion bits of data back to Earth. To stay locked on Earth, its antenna has made over five million rotations relative to the spinning spacecraft. The Venus Orbiter has made over 100 maneuvers and traveled 145 million km (90 million miles). The spacecraft gamma

- more -

ray burst instrument has recorded 75 gamma bursts from various parts of the galaxy. Pioneer's other 17 experiments have made a variety of measurements of Venus's atmosphere and surface, its interior, and surrounding environment.

For the first two years of its mission, maneuvers commanded from Earth have maintained the spacecraft orbit in one fixed position relative to the planet. From now on Pioneer's orbit will be allowed to "float" responding to pressure from solar radiation and Venus and solar gravity. This means that the orbit, now tilted  $17^{\circ}$  to the equator will drift down until it coincides with Venus's equator in 1986. This also means that its orbital low point will rise from 150 km (93 mi) above the planet's surface in 1980 to 2200 km (1365 mi) above it in 1986. After 1986, orbital low point will reverse direction, dropping downward until it is so low that the spacecraft enters the atmosphere and burns up in 1992. At this point orbital tilt will have returned to  $17^{\circ}$  to the equator, but with orbital low point in the southern rather than northern hemisphere.

As Pioneer's orbit changes position during this "float" period, it will be possible to measure the planet's bow shock wave and wake region or "tail" in the solar wind and other planet-solar wind interactions at a variety of places not now reachable by the spacecraft. Gravity-sensing experiments will be improved because the small rocket thrusts made to maintain spacecraft position will no longer be needed. It should be possible by this gravity sensing to make detailed and precise maps of mass concentrations in Venus' crust. Virtually all other instruments can continue making their

measurements, providing a longer time to study such things as periodic long-term changes in cloud circulation. Other instruments will be able to study planet-solar interactions during a large portion of, or even for a complete solar cycle. There should be significant changes in Venus' upper atmosphere as the Sun comes down from its present high activity period.

Cooperative measurements may take place with Russian Venus spacecraft, expected to arrive at the planet in 1982 and 1984.

The Pioneer Project is managed by NASA's Ames Research Center, Mountain View, CA. The spacecraft were built by Hughes Aircraft Co., Space and Communications Group, El Segundo, CA.

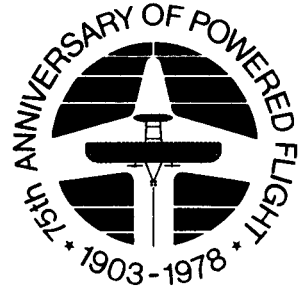
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December 1, 1980

# NASA News

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IMMEDIATE

## NASA U-2 SPOTS FIRE THROUGH SMOKE

NASA Ames Research Center's Earth Resources Survey Aircraft (U-2) is providing real-time infrared images of smoke-obscured landscapes for use in firefighting by the U.S. Forest Service, National Park Service and the California Department of Forestry.

The U-2 real-time images were used for the first time Oct. 2 for a fire in Kings Canyon National Park, located in the Sierra Nevada north of Sequoia National Park. In Kings Canyon, thick smoke obscured aerial views of the fire, and treacherous terrain made deployment of firefighters and equipment dangerous without a known fire perimeter.

"The U-2 was invaluable," according to the National Park Service's Kathy Davis. Kings Canyon is steep and rocky, she noted. To work some areas of the fire, crews had to hike four hours each way.

The U-2 images made detection of the fire boundary easier and safer, she said, by giving firefighters the size, shape, direction of burn and hot spots of the fire.

"If you're sending your people in, you'd better know

(more...)

December 11, 1980

## U-2 Spots Fire

2-2-2

where the fire line is," Davis said, because lives may be lost with inaccurate information.

Using a Daedalus Multispectral Scanner and a Fairchild Charge-Coupled Device (CCD) Linear Array Scanner, a NASA U-2 flying at 21 km (about 65,000 ft) sends data directly to a small antenna at Ames.

The digital information is processed into hard-copy images, then immediately transferred to U.S. Geological Survey maps of the terrain. The USGS maps then are transmitted by telecopy machine directly into the fire control camp, where the fire control manager uses them to make decisions about deploying manpower and equipment.

The entire process, from U-2 to fire camp, takes less than 10 minutes. The aircraft can fly over a fire, providing information on fire propagation, for as long as five hours.

With the Ames antenna, the data can be transmitted from the U-2 flying anywhere within a 500 km (300 mi) radius of Ames, which is located near San Francisco. This radius -- north to the California border, south to Los Angeles, east to central Nevada and west to the Pacific Ocean -- covers virtually all forested lands in California. Additional ground stations would increase the radius, and direct transmission to a satellite would allow real-time observations anywhere in the world.

Future flights will combine the high-resolution imagery of near-infrared, which reveals water sources close to the fire, with thermal infrared, which "sees" through the smoke to expose the fire perimeter.

The Daedalus Multispectral Scanner thermal infrared channel

(more...)

12/11/80

## U-2 Spots Fire

3-3-3

(eight to 14 microns) provides fire intensity information unobscured by dry smoke. Ground resolution is about 25 m (82.5 ft). Data is transmitted digitally at 75,000 bits/second, converted into an analog signal by a simple, ground-based processor and displayed as a photographic image on dry silver paper by a Tektronix 4633 Continuous Recorder.

The Fairchild Charge-Coupled-Device (CCD) Linear Array Scanner consists of 1,728 electronically scanned detectors at the focal plane of an 85 mm focal-length lens. Spectral sensitivity is .4 to 1.1 microns. Smoke penetration and burn-area definition has been best with a far-infrared filter allowing sensitivity beyond .8 microns. Ground resolution of about 4 m (13.2 ft) provides the high-resolution imagery needed for definition of access roads and water sources.

The thermal infrared imagery scale is 1:62,500, closely matching the USGS 15-minute topographic map series. The high-resolution imagery scale is 1:24,000, matching the USGS 7½-minute series. These matched image scales facilitate the transfer of the infrared information to the USGS base maps.

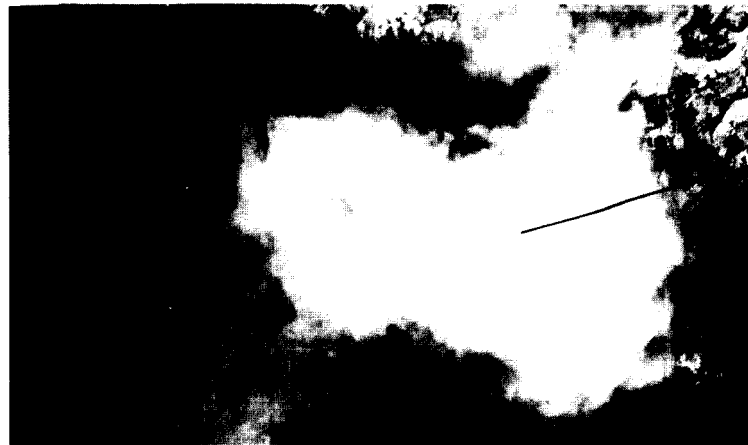
The U.S. Forest Service and the California Department of Forestry plan to use the U-2 real-time imagery during the next fire season.

John Arvesen, of Ames High Altitude Missions Branch, designed the real-time system for the U-2. The High Altitude Missions Branch, including U-2 operations, is managed by James W. Cherbonneau.

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12/11/80

## EFFECT OF WAVELENGTH ON SMOKE PENETRATION



SMOKE

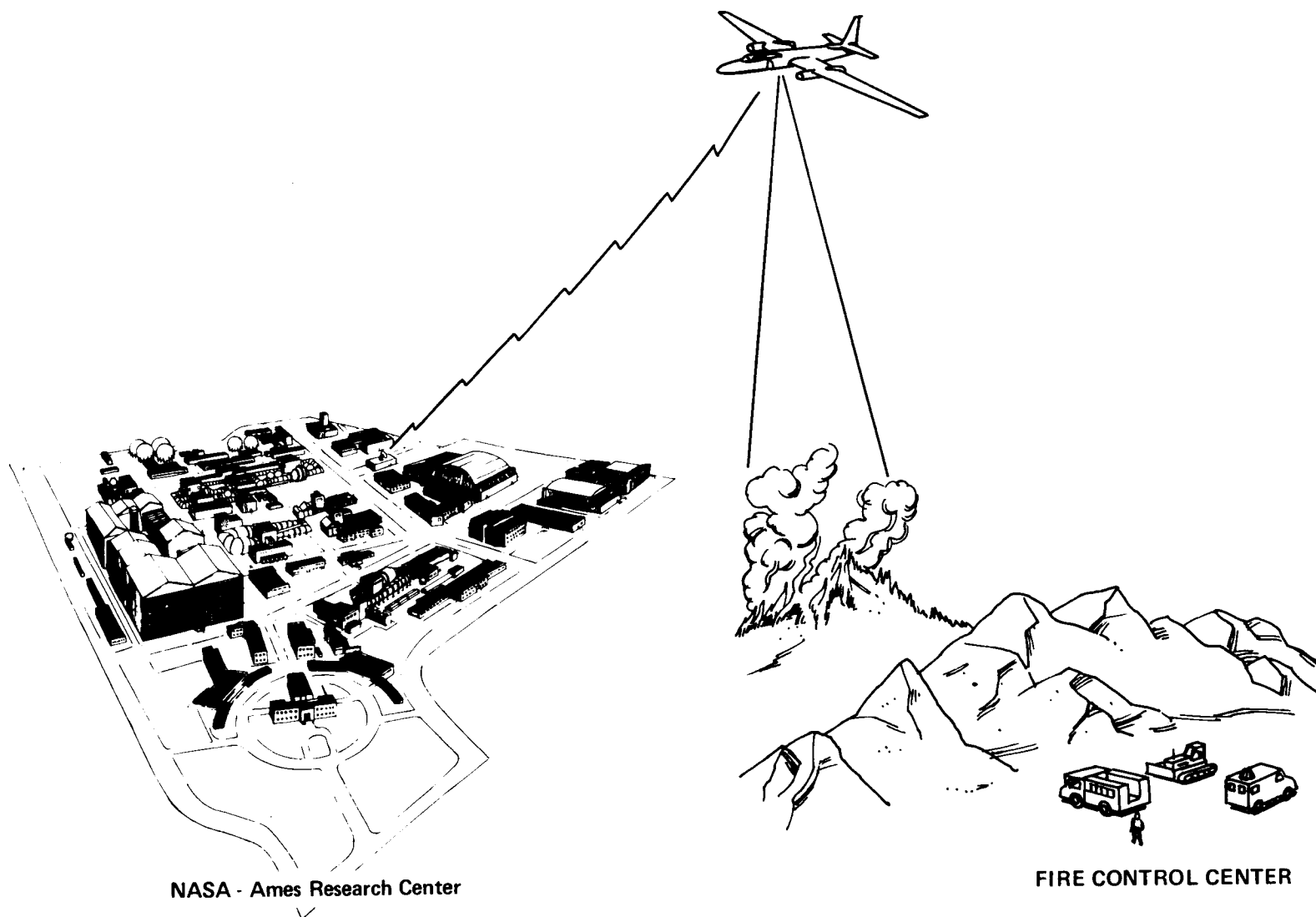
VISIBLE



FIRE  
PERIMETER

THERMAL INFRARED

## NASA U-2 REAL TIME IMAGERY



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IMMEDIATE

## NASA TO STUDY EFFECTS OF "JET LAG" ON PILOT PERFORMANCE

NASA's Ames Research Center has begun a project to determine how irregular work schedules, disrupted sleep patterns and frequent crossing of time zones affect airline pilot performance.

Studies in animals and humans have shown that interruption of biological cycles can cause reduced performance, fatigue, loss of attentiveness, short-term memory lapses and decreased alertness.

Scientists say pilots may suffer this "circadian desynchronosis" (sometimes called "jet lag"), which is the disturbance of 24-hour biological rhythms, especially sleep cycles.

Although research has been conducted on biological rhythms in shift workers, truckers, railroad engineers and ship crews, little research has been done with airline crews.

-more-

January 2, 1981

The Ames Life Sciences study will have four parts: the large body of existing scientific literature on circadian rhythm will be translated into lay terms and disseminated to the aviation community; a field study will be conducted to determine rest, sleep, dietary and drug use patterns of commercial airline crews; current simulation facilities will be used for studies of altered sleep and nutrition patterns; and a new Ames simulation facility, planned for completion in 1983, will be upgraded to provide a laboratory for further investigations.

NASA was asked to study the subject of pilot fatigue by Rep. Barry Goldwater Jr. of the House Committee on Science and Technology.

Three preliminary activities helped NASA design the current project: a workshop held in August, a review of research literature completed in July, and an analysis of safety reports finished in September.

The August workshop was conducted by the Ames research team leaders -- Dr. Joseph C. Sharp, deputy director of Life Sciences, Dr. Alan Chambers, chief of the Man-Vehicle Systems Research Division, and Dr. Charles M. Winget of the Biomedical Research Division.

Airline, research and Federal Aviation Administration personnel who participated in the workshop agreed that there is a pilot fatigue problem, but they could not agree on its magnitude. Research on the subject was strongly recommended.

Meanwhile, a group of life scientists reviewed the scientific literature and prepared an extensive, 600-page

bibliography on the disruption of circadian rhythms, and another group analyzed files from the NASA Aviation Safety Reporting System. (Since 1976, this system has provided an anonymous reporting mechanism run by NASA for the FAA.) Although relatively few fatigue-related reports were found, researchers believe more incidents may be the result of fatigue than are recognized by those reporting them.

Ames' current, four-pronged research program was designed to discover how much circadian desynchronosis affects pilots. Project scientists will try to develop ways to avoid, minimize or counteract its effects and to discover tolerance limits, beyond which performance becomes hazardous.

Ames' Human Research Facility has been used primarily to study simulated weightlessness induced by prolonged bedrest. The facility's beds, kitchen and test equipment can be used to study airline crews. As voluntary subjects, crew members' sleep and nutrition patterns could be altered while they are tested for vigilance, eye-hand coordination and other motor skills.

The \$8-million Ames Man-Vehicle Systems Research Facility which consists of two simulated airplane cockpits and an air traffic control simulation, is being built solely for research in human factors in aviation. When completed in 1983, this facility will make an ideal laboratory for full-scale simulation of flight missions with airline crews as volunteer subjects.

-end-

January 2, 1981

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## QSRA COMPLETES SUCCESSFUL PILOT EVALUATION PROGRAM

The Quiet Short-Haul Research Aircraft (QSRA) has completed a successful 43-flight evaluation program in which 22 visiting pilots each made two flights in the aircraft.

The QSRA is a modified deHavilland Buffalo (C-8A) with a new moderately swept wing and four Lycoming YF-102 engines which are mounted on the wing to provide propulsive lift using the upper surface blowing (USB) concept.

The pilots, most of whom were test pilots, represented 16 organizations. Each attended a day-long lecture and briefing program at NASA's Ames Research Center prior to flying the aircraft. Each pilot's first flight was devoted to aircraft familiarization and to making short takeoffs and landings (STOL) with all systems operational.

In the second flight, each pilot made short runway landings with malfunctions such as engine-out, stability augmentation system (SAS) inoperative, other inoperative systems and with combinations of malfunctions. Flight paths

-more-

January 7, 1981

for landing approaches ranged from  $4\frac{1}{2}$  degrees to  $7\frac{1}{2}$  degrees.

Most pilots agreed the QSRA was relatively easy to fly. They were able to make safe approaches into the equivalent of a 2,000-foot runway in the second flight despite malfunctions.

Each evaluation pilot flew about 30 landings in the QSRA during the program. The two NASA safety pilots, Bob Innis and Jim Martin, made more than 600 landings during the seven-week period.

NASA designed the pilot evaluation program to introduce QSRA technology to potential users, to obtain feedback from users on the future of the program and to get an independent critique of QSRA technology.

The QSRA program is managed at Ames by John A. Cochrane, who termed the pilot evaluation a "complete success."

Participating pilots and engineers represented NASA's Ames Research Center, Dryden Flight Research Center and Langley Research Center, as well as the U.S. Navy and Marine Corps, the Federal Aviation Administration, the U.S. Air Force, Boeing, McDonnell-Douglas, Lockheed, deHavilland, Grumman, ALPA, USAIR, United Airlines and Ransome Airlines.

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January 7, 1981

# NASA News

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FOR RELEASE: Immediate

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## NASA DRYDEN COMPLETES SHUTTLE TILE TESTS

Actual flight tests of the Space Shuttle thermal protection tiles on an F-15 and F-104 aircraft have been completed by NASA's Dryden Flight Research Center. Approximately 60 flights were flown in the 12-month flight test program.

Tile sections representing six different locations on the orbiter have been flown at 1.4 times the aerodynamic load conditions that the Shuttle will encounter during launch. The six different tile locations on the orbiter that were flight tested by NASA Dryden are the closeout tile aft of the wing leading edge area, the forward wing glove area, vertical tail leading edge, window post area, elevon trailing edge, and elevon hinge area. Maximum speeds of 1.4 times the speed of sound and dynamic pressures of 1140 pounds per square foot were achieved during the program. Following each flight the test section was inspected and precisely measured to identify any deformation or structural changes that may have occurred as a result of the flight loads.

As the result of the Dryden flight test program, design changes of varying degrees have been made to the thermal protection system

-more-

on the under side of the orbiter wing leading edge, on the wing glove area, around the window posts, and on the vertical tail leading edge.

These changes consisted of revision of attachment techniques to improve binding forces, modified gap filler assemblies to prevent detachment, and improved installation and testing techniques to ensure satisfactory compliance with design requirements. Changes to correct deficiencies resulting from flight airloads were re-tested after modification to assure satisfactory performance and have been incorporated into the Shuttle orbiter.

-end-

January 7, 1981

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IMMEDIATE

## NASA TO BUILD NEW TEST FACILITY FOR AVIATION SAFETY RESEARCH

A first-of-its-kind simulation facility dedicated to aviation human factors research soon will be built at NASA's Ames Research Center.

Designed for study of the interaction between flight crews, their aircraft and air traffic control, the Man-Vehicle Systems Research Facility will allow research never possible in existing NASA flight simulators which were intended primarily for aeronautical rather than human engineering research.

The \$7.5 million dual-simulator facility, scheduled for completion in 1983, will give scientists their first opportunity to identify and study psychological factors in the little understood, highly complex relationship between pilots, crew members and today's aircraft, as well as the advanced aircraft of the future.

One of these simulators will be a replica of a current transport airplane cockpit, complete with flight engineer's station, flight display and control systems.

-more-

January 8, 1981

The second simulator will represent transport aircraft of the future. With advanced technology flight controls, displays and other flight deck systems to accommodate a flight crew and observer, the advanced simulator will be designed to test for human factors related to the newest aviation technology.

The simulation complex will include a visual display capable of depicting dusk or night, aircraft, fog, clouds and other weather conditions, allowing the experimenter to recreate and control visual, as well as operational, workloads.

A mock Air Traffic Control Facility will complete the realistic flight simulation.

The equipment will allow complete simulation of a flight mission, with the experimenter able to introduce problems such as turbulence, air traffic, fog or mechanical failure.

Dr. David Nagel, an aviation psychologist, and Rodger Hayes, project manager, are responsible for development of the facility, which is scheduled to begin construction in April.

The Aviation Safety Reporting System, operated by NASA for the Federal Aviation Administration, has since 1976 provided a means for anonymous reporting of aviation incidents related to air safety. NASA's involvement in the reporting system has highlighted the problem of human error to NASA scientists.

Studies by a number of organizations have indicated that human error plays a part in about 80 percent of all

aviation accidents.

In the Man-Vehicle Systems Research Facility, scientists will study how decisions are made in the cockpit and how an aircraft captain manages resources, such as time and people, during critical moments.

Automation is another prime target of human factors research. The enhanced efficiency of automation may not always offset its disadvantages. Pilots who fly planes which are highly automated often have trouble readjusting to planes with little automation. If flight skills have eroded from lack of use, pilots may not respond properly when an automated system fails.

Advanced technology displays, controls and other instrumentation must be tested for human factors as well as engineering feasibility. As crowded airspace forces planes closer together, researchers will be testing new instrumentation designed to keep the airways safe.

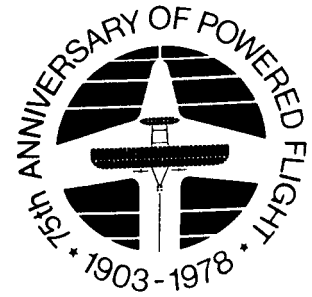
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January 8, 1981

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IMMEDIATE

## NEW AIRCRAFT FOR HIGH ALTITUDE STUDIES

A new high altitude aircraft designed to carry nearly two tons of instruments 13 miles high is scheduled for delivery to NASA's Ames Research Center in April 1981 by the Lockheed-California Co.

Designated the NASA ER-2 (for Earth Resources) aircraft, it will augment research programs being carried out by two Lockheed U-2 aircraft now at Ames. The ER-2 is similar to the U-2R and the new TR-1 now in production for the USAF. It is a one place single engine jet aircraft designed to cruise above 21,000 meters (70,000 feet) at a speed of 770 kilometers per hour (478 miles per hour) and has a range beyond 3,000 miles.

Payload compartments in the aircraft's nose section, a section behind the pilot, and in wing pods, will be capable of carrying a variety of cameras, an imaging radar, and other sensors for scientific measurements in the stratosphere and for Earth resources studies.

-more-

January 30, 1981

## High Altitude Studies

2-2-2

The ER-2 Contract was let for NASA in November 1979 by the Air Force Acquisition Logistics Division, Air Force Logistics Command, headquartered at Wright-Patterson Air Force Base, Ohio.

Based at Ames Research Center, the ER-2 will be employed on NASA missions under the direction of the Office of Space and Terrestrial Applications at NASA Headquarters, Washington, D.C.

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January 30, 1981

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IMMEDIATE

## EARLY VENUS ATMOSPHERE GOT BIG INPUT

### FROM SUN, PIONEER-VENUS DATA SUGGESTS

Data from the Pioneer Venus probes suggests a far larger contribution by the Sun to Venus' atmosphere than was received by the Earth from the Sun during early evolution of the solar system.

Venus' atmosphere has far less of the noble gas krypton than might have been expected. The planet has less krypton than is found on the Sun and more than on Earth.

The krypton measurements are the first ever made on the planet, and they appear to provide some basic evidence about the formation of the early solar system. They were made by the Pioneer Venus probe mass spectrometer as it descended through Venus' dense atmosphere on Dec. 9, 1978. The Pioneer project is managed by NASA's Ames Research Center, Mountain View, CA.

The determination of the amount of the krypton and an upper limit to the amount of xenon on the planet was announced by Dr. Thomas Donahue, University of Michigan.

- more -

How the quantities of the two noble gases, krypton and xenon, can tell us about the formation of Venus' atmosphere is a solar system detective story, says Donahue.

Venus received a large input of various gases from the Sun in the early solar system, during a half-million-year period of much denser solar wind than today's, Donahue suggests. (This concept of enhanced solar wind contributing a large amount of rare gases to Venus was first proposed by Dr. George Wetherill, Director of the Carnegie Institution, Washington, D. C.).

The material which blew out from the forming Sun during this relatively short period would have impacted upon the mass of material condensing around Venus' orbit to become the planet. In its turn, the proto-Venus material would have blocked off the enriched solar wind, preventing it from blowing farther out to the then forming Earth and Mars. Hence, today's Earth is relatively deprived of the two gases krypton and xenon, as well as of other noble gases such as argon.

The theory is further strengthened by earlier Pioneer findings about the amount of primordial argon (argon 36) on Venus. Pioneer found that Venus has 75 times as much argon 36 in its atmosphere as the Earth has, a profound discovery.

The excess argon was discovered by the gas chromatograph experiment of Vance Oyama, NASA Ames, and the mass spectrometer experiment of Dr. John Hoffman, University of Texas, Dallas, who demonstrated that the excess was the argon 36 isotope.

Various theories have been proposed for Venus' large

amount of primordial argon. These have suggested that the planet had an unusually efficient way of trapping noble gases like argon, krypton and xenon during its formation. (Noble gases usually will not combine chemically with other elements.) Therefore, scientists believed that, along with its argon, Venus would have something like 75 times as much krypton and xenon as the Earth. Instead, Dr. Donahue found from the Pioneer data that Venus has only about three times as much of these two gases as the Earth. (For various reasons, he was only able to set an upper limit for xenon -- not more than 30 times the amount on Earth but probably much less.)

However, the most interesting thing, says Donahue, is not that Venus has three times as much krypton as Earth, but that the planet has 700 times as much primordial argon as it has krypton. This compares with an argon/krypton ratio for Earth and Mars of only 30 to 1. The reason this is so interesting is that the Sun has 2,000 times as much argon as krypton.

Since Venus has far more of all three of these gases than Earth, and has them in proportions more like those of the Sun than of the Earth, there is strong likelihood the gases came from the Sun. And this provides some real evidence about early formation of the solar system.

The Pioneer Venus orbiter spacecraft continues to return pictures and other data on Venus and its atmosphere, and is expected to produce data through 1985. The four Pioneer probe craft entered Venus' atmosphere in December 1978, providing the mass spectrometer data.

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## NASA INVENTOR OF THE YEAR HONORED FOR MEDICAL CONTRIBUTION

Thomas Fryer, a 30-year employee of NASA's Ames Research Center, has been named NASA Inventor of the Year for 1980. Fryer, who was chosen from inventors at NASA facilities, was cited for his work in medical electronics.

The winning device, completed by Fryer in 1977 and patented in 1980, measures intracranial pressure. Above normal intracranial pressure can cause irreversible brain damage if not detected and relieved by surgery or medication.

Working with NASA's Stanford Biomedical Applications Team and with Dr. Gerald Silverberg, neurosurgeon at Stanford University Medical School, Fryer produced the 1/4-inch-diameter device which can be implanted in the skull of a patient suffering from head injury, brain tumor, hydrocephalus (fluid accumulation in the brain), stroke or brain infection to monitor changes in pressure.

Past and present devices have had severe limitations. Some have wires which protrude from the patient's scalp. Some leaked, could be damaged by body fluids or posed a risk of

(more) .

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infection. Most are not accurate enough for precise medical monitoring.

Because Fryer's detector is small, noncorrosive, accurate, and free of batteries and connecting wires, it may be implanted in the skull for as long as necessary to monitor pressure. Power for the unit is obtained from a small, battery-operated, portable power oscillator placed near the patient's head.

Fryer, an engineer, started with large-scale and semi-miniaturized devices used to measure pressure on air foils in Ames wind tunnels some 10 to 15 years ago. Fryer modified the technology to make it acceptable for human use. He used a miniature titanium pressure cell which can be placed harmlessly in the body and is impervious to body fluids. He modified existing detectors to operate without wires (using a capacitance rather than a strain gauge principle). He reduced the size of existing units by 50 percent.

Most important, Fryer's device will give accurate, stable readings of measured pressure for weeks or months -- which had not been possible with previously existing detectors.

The electronic detector and pressure transducer is implanted in the cranium, just under the skin. It has a diaphragm which fits up against the dura (the tough, fibrous outer membrane that envelops the brain), where it can sense even the smallest change in pressure.

Fryer's titanium-based unit was built by Konigsberg Instrument Co. of Pasadena. The detector is being used by

(more)

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neurosurgeons at Stanford University Medical Center. Licenses to manufacture the monitors have been given to Pacesetter Systems, Inc., Sylmar, Calif., and Cordis Corp., Miami, Fla.

Fryer was born in Peking, China, where he lived until age 12, when his family moved to the San Francisco Bay area. He attended the University of Michigan, graduating with a bachelor's degree in engineering.

After college he worked for two years at the Naval Research Laboratory in Washington, D.C. He came to work for the National Advisory Committee for Aeronautics (NACA -- NASA's predecessor) at Ames in 1949. He retired in 1979 from Ames' Research Facilities and Instrumentation Division.

Since retiring, he has started a medical electronics company called Biomedical Monitoring Systems, Inc. Fryer lives in Saratoga, Calif., with his wife, Idalene.

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March 11, 1981

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IMMEDIATE

## R.T. JONES TO RECEIVE PRESIDENT'S AWARD

Dr. Robert Thomas Jones, senior scientist at NASA's Ames Research Center, will be presented the President's Award for Distinguished Federal Civilian Service on Friday, March 13, at Ames.

Jones discovered the theory of the "simple sweepback," one of the most important discoveries in aerodynamics (swept wings are seen on most jet aircraft today). He is an internationally acclaimed expert on aerodynamics, optics and biomechanics, as well as an applied mathematician, astronomer, inventor, author and violin-maker.

The medal and certificate, the highest honors given by the federal government to a career employee, are awarded for outstanding achievements which "exemplify, to an exceptional degree, imagination, courage and high ability in carrying out the mission of the government." The award is given to no more than five persons each year. Prior NASA recipients include Wernher von Braun, Hugh L. Dryden, Robert R. Gilruth, Homer E. Newell and William H. Phillips.

(more)

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Jones was selected for the award by former President Jimmy Carter. In 40 years of government service, his many contributions include the narrow, triangular wing, the independence principle for three-dimensional boundary layers and the concept of the oblique (yawed) wing for supersonic aircraft.

Jones, who never finished college, was awarded an honorary doctorate of science in 1971 by the University of Colorado for his "scientific eminence and his service to society."

He dropped out of college in 1928 after one year at the University of Missouri. Because he found books on aerodynamics more exciting than required freshman texts, he went to work for Charles Fowler's Flying Circus, carrying gas cans, patching wing tips and getting paid in flying lessons.

At 19, Jones was working for Nicholas-Beazley Aircraft in his home state of Missouri when he designed a 576-pound race plane, which later was the subject of the first of more than 65 technical papers he has authored.

When the aircraft company folded in 1930, Jones went to Washington, D.C. He got a job as an elevator operator in the House Office Building, where he met Dr. Max Munk, a pioneer in aeronautics who had been a scientist with the National Advisory Committee for Aeronautics (NACA - NASA's predecessor).

Jones had read Munk's "Fundamentals of Fluid Dynamics for Aircraft Designers." The elevator boy so impressed Munk

(more)

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that Munk gave him an oral exam and enrolled him in graduate courses at Catholic University. Jones studied airfoil theory, vector analysis and relativity theory under Munk in three years of night classes.

Jones' career with NASA began in 1932, when he went to work on a nine-month Public Works Administration assignment at NACA's Langley Memorial Aeronautical Laboratory (now NASA's Langley Research Center) in Virginia.

He stayed on at Langley, and by World War II had published important papers and become well-known in aeronautical circles. Jones' 1944 discovery of the sweepback theory was not accepted by most scientists at the time, but NACA began experiments to test the theory. When the Allies defeated Germany, U.S. scientists discovered the Germans knew about the effect of sweep and were incorporating it in new aircraft designs.

For his discovery of the sweep effect and other contributions, Jones was given the Sylvanus Albert Reed Award by the Institute of the Aeronautical Sciences in 1946. That same year, he came to work for Ames Research Center.

About that time he became interested in telescopes. He studied geometrical optics, learned the art of grinding spherical mirrors and set up an optical shop in his garage, where he built telescopes and lenses.

Although most of Jones' scientific writings have dealt with lift, drag and fluid flow, he also has written papers about telescopes, interplanetary travel time, relativity and a design for an artificial heart (a fluid flow problem).

(more)

March 11, 1981

In 1963, Jones left NASA to work for AVCO Everett Research Laboratory, where he applied fluid dynamics to the problems of blood flow. Returning to Ames in 1970, he went back to work on his oblique wing concept. An oblique wing research aircraft now is being tested at NASA's Dryden Flight Research Center, Edwards, Calif.

Jones was to discover yet another interest, this one related to the rearing of his six children. When his daughter Patty became a violinist, Jones studied the mechanics and principles of violin-making, fashioning eight traditional violins as well as an electronic instrument.

In 1973, Jones was elected to the National Academy of Engineering and the American Academy of Arts and Sciences. He was honored in 1976 with a cash award from NASA's Inventions and Contributions Board and received the Prandtl Ring Award in 1978 from the German aeronautics society (Deutsche Gesellschaft fur Luftund Raumfahrt), considered the highest honor in the field of fluid dynamics. A Fellow of the American Institute of Aeronautics and Astronautics, Jones in 1979 was chosen for the award of Honorary Fellow.

A native of Macon, Mo., Jones now resides in Los Altos Hills, Calif.

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March 11, 1981

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IMMEDIATE

## VENUS CLOUD STUDIES SHOW CHANGES IN LONG-TERM GLOBAL WIND PATTERNS

Significant discoveries concerning the pattern of atmospheric changes on Venus have been made based on two years' worth of Pioneer Orbiter observations. The discoveries indicate a long term period of change for both the planet's wind patterns and for the presence and absence of a deep haze layer above the clouds.

The Pioneer Orbiter has taken about 1000 pictures of Venus' clouds and extensive measurements of the particles composing these clouds.

The most noteworthy of the discoveries is that Venus' planet-wide wind patterns change dramatically over a period of years. Two circulation patterns have been discerned--a mid-latitude jet stream pattern, which is succeeded in several years by a pattern of cloud and wind circulation like that for a single rigid body.

A second discovery shows that the high-altitude haze layer which completely envelopes Venus' clouds appears and disappears over several-year periods. This haze is a "smog layer" extending above the main cloud region by about 30 km (18 miles). Thirty km on the Earth (which is the same size as Venus) would be a distance extending from the surface well into our stratosphere.

March 9, 1981

The Pioneer Venus Orbiter is expected to return pictures and other planet data until 1985. The Orbiter reached Venus in December 1978, and the four Pioneer probe craft entered the atmosphere at the same time. Cloud pictures and polarimetry data are provided by the Cloud Photopolarimeter. Dr. Larry Travis, NASA Goddard Institute for Space Studies, New York City, is Principal Investigator. The Pioneer Project is managed by NASA's Ames Research Center, Mountain View, CA. The spacecraft were built by Hughes Aircraft Co.

The two new discoveries of a multi-year change in the pattern of global winds, and similar changes in a planet-wrapping haze layer should help explain the major remaining mystery of Venus' atmosphere: Why on a planet which has almost no axial rotation do the upper level winds circle the planet at tremendous speeds of 360 kph (225 mph). These winds cover the planet completely, blowing at virtually every latitude from equator to pole. Their speeds can be determined from the speeds at which the clouds, carried by the winds, travel around the planet.

Wind speed measurements from top to bottom of the atmosphere <sup>four</sup> by the Pioneer probe craft show that these high-speed, cloud-level winds are coupled to lower altitude winds, which also have very high speeds. The 225 mph cloud level winds blow around the planet at an altitude of 65 km (40 miles). Wind speeds then range down to 120 mph at 50 km (30 miles) altitude and to a still-very-high 50 mph at 20 km (12 miles) altitude.

The mass of atmosphere represented by these high-speed winds is several times that of the entire Earth's atmosphere. It represents about a quarter of Venus's atmosphere. Venus' atmosphere is about 100 times more massive than Earth's.

Despite the scale of these high-speed, upper level winds, well

over half of Venus' tremendously massive atmosphere, down near the planet's surface, is almost stagnant. From the surface up to 10 km (6 miles) altitude, wind speeds are only about 2 to 11 mph.

In a general way, the high-speed winds can now be explained by the fact that the huge momentum of Venus' slow-moving, massive lower atmosphere is transferred to higher altitudes where the atmosphere is much less massive, so that the same momentum becomes a much higher velocity.

These new discoveries of long-term changes in global wind patterns and an enormous haze envelope which appears and disappears should help scientists define the "driver" for the planet's high-speed winds. Any future general atmosphere circulation model for Venus will have to produce these long-term changes in wind and cloud patterns.

Details of these and other major findings from the two-year analysis of the Venus cloud and polarimetry data are:

- 1) It is now clear that the high-speed movements of Venus' clouds around the planet are not caused by wave motions in the atmosphere, as was thought by a number of scientists, but are real winds, though there are some wave motions as well. These planet-circling winds, which carry along the clouds, are the same ones which were measured by the four Pioneer Venus probe craft as they descended to Venus' surface in December 1978. These winds blow "backward" in an east to west direction, circling the planet once every four days at speeds near the equator of 350 kph (225 mph), and near the poles (at around 70° latitude) of 160 kph (100 mph). The Pioneer cloud pictures show the region of Venus' main cloud deck at altitudes between 60 and 65 km (37 and 40 miles) above the planet's surface.

2) The global pattern of these planet-circling, cloud level winds appears to change periodically. For the past two years of Pioneer observations, Venus' clouds and cloud-level winds have been showing "solid body" rotation.

They move around Venus as though they were made up of one rigid, planet-encasing body. This pattern of motion, of course, means wind speeds are much higher at the equator than at the poles.

3) However, in 1974 when the Mariner spacecraft flew past Venus, the clouds did not circle the planet as a rigid body, and there were mid-latitude jet streams at around  $45^{\circ}$  latitude. These higher-speed winds had velocities of around 400 kph (245 mph), while wind velocities at the equator were some 40 kph lower, at 360 kph (220 mph).

This seems to show that there is an irregular cycle of change in the pattern of these cloud-level winds--perhaps several years in length. The duration and rate of change of this cycle of changing wind patterns would be of fundamental interest in understanding the high-speed flow of Venus' upper level winds around the planet, as well as behaviour of the general atmosphere circulation.

4) In addition to circling the planet, measurements of Venus' cloud level winds show that they also blow toward the poles at speeds of around 25 kph (15 mph). These equator-to-pole winds (also seen by the four Pioneer Probes at lower altitudes) carry the heat from the Sun, absorbed at Venus equator, to the poles.

The speeds of these equator-to-pole winds agree with the wind measurements by the four Pioneer Probes. This shows that the cloud-level winds are the upper limb of the equator-to-pole Hadley cell circulation loop, which carries Venus' equatorial heat poleward.

5) The so-called global "Y" pattern of Venus clouds with the tail of the "Y" extending eastward around the planet, and the arms

westward, does appear at times, but is not typical. The "Y" was first seen in ground observations. Sometimes the "Y", which occasionally extends two-thirds of the way around the planet, disappears completely. At other times, it is so changed that it forms a "C" or other shape. In general, the planet shows a whole range of global cloud patterns beside the "Y".

6) In addition to its well-known veil of clouds, two years of Pioneer polarimetry measurements show that Venus is currently enveloped in an 18-mile-thick blanket of high-altitude haze. The haze is present everywhere, but has about three times more particles per unit volume at the poles than at the equator. At the poles, the haze is so thick that it obscures the base clouds beneath it.

This haze of tiny sulfuric

acid droplets is the "sealer" of Venus' greenhouse effect, holding some additional heat beyond that which would be trapped by the clouds and atmosphere alone. The planet's 900° F surface temperature would be somewhat lower without the haze. Furthermore, including its effects makes the heat radiation models developed by scientists for Venus match the atmosphere structure at the cloud tops observed by various of the Pioneer Venus craft.

Venus' main clouds consist of sulfuric acid particles 2 microns in diameter, while in the haze layer, the particles are smaller, only a quarter of this size.

Over the next five years of the Pioneer Venus Orbiter's extended mission (through 1985), Dr. Travis will be watching the clouds for changes. He will be looking for changes in the global circulation pattern, such as the one which occurred in the five years separating the Pioneer and Mariner missions (1974-

1979). Such factors as how rapid is the change and how often it occurs should further help with understanding of the Venusian high-speed winds.

# NASA News

National Aeronautics and  
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*Am 23*

Peter Waller 415/965-5091

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IMMEDIATE

## USAF TESTS SPACECRAFT HEATSHIELD FOR NASA GALILEO PROBE TO JUPITER

Projectiles fired at speeds of 18,000kph (11,000mph) in an Air Force ballistic range are being used to determine heat-resistant qualities of spacecraft heatshield materials for use on NASA's Galileo Entry Probe System---an exploratory space mission designed to investigate the atmosphere of Jupiter.

NASA now plans to launch the probe in 1985 from the cargo bay of the Space Shuttle. The journey to Jupiter will take three years, and the 315 kg (693 lb) Galileo Probe will enter the atmosphere at a speed of 185,000kph (115,000mph). Following jettisoning of the forebody and afterbody heatshields, the system will descend on its parachute. The current design allocates approximately one half of the probe to heat shield. The probe will then relay data back to earth--a distance of around 650 million km (400 million miles). The probe will make atmospheric measurements down to a depth where pressure is approximately 20 Earth atmospheres--like being under 700 feet of water. The descent will take about 60 minutes.

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The first of eight ballistics range shots of a projectile representing the Galileo Probe vehicle has been conducted in the 300 meter (1,000 foot) long hypersonic range "G" at the USAF's Arnold Engineering Development Center, Tullahoma, TN.

The 5 cm (2 inch) diameter 45-degree-angle nosecone was covered with a carbon/phenolic heat-resistant material, designed and fabricated by General Electric Company, to protect the spacecraft's delicate instrumentation during its entry into the harsh atmosphere of Jupiter.

The projectile was fired downrange--propelled by a two-stage gas gun launcher--at about 18,000kph (11,000mph,) and generated peak surface temperatures of about 3300° (6,000°F). X-ray and pulsed laser photography was used extensively during the projectile's split-second journey downrange. Open shutter cameras were used to capture pulsed-laser lighted images of the projectile in flight in 20-billionths of a second, allowing test crews and engineers to determine how much heatshield mass was eroded, at various intervals down the range, from the test material by ablation or aerodynamic heating and fragmentation.

The projectile traveled downrange on a special four-rail track which guided the model through the test chamber and into a pressurized recovery tube which decelerated the model. After passing through the recovery tube, the model entered a tapered rail section and was slowed to a stop by friction.

Engineers then were able to examine the recovered

projectile and determine precisely how much heatshield mass was lost due to aerothermodynamic erosion. This will help NASA to decide on the required thickness of material to protect the probe spacecraft when it enters Jupiter's atmosphere.

The Galileo Probe program is being managed by NASA's Ames Research Center at Moffett Field, CA, with the spacecraft being built by Hughes Aircraft. The heatshield is being provided by General Electric under a subcontract.

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# NASA News

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*Mar 26*

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IMMEDIATE

## NOTE TO EDITORS:

NASA Ames is doubling the size of its world's largest wind tunnel, the "40 by 80", and converting it in the process into two huge tunnels.

The tunnel, which moves 60 million cubic feet of air per minute, is a unique national facility. It is large enough to test full-scale airplanes with their engines running, and has operated at two shifts a day for 30 years. It has tested most important U. S. aircraft designs including the space shuttle.

The \$85 million tunnel conversion project will give the U. S. major new tools to maintain its position as world leader in aeronautics, a position currently threatened by European producers. At \$14 billion annually, aircraft are the country's largest earner of foreign exchange, larger than total agricultural exports. Such exports help pay for the \$40 billion of foreign oil the U. S. now imports each year.

A tour and briefing on the new dual tunnels and their planned uses will be held at Ames at 11 a.m., Tuesday, March 31. The last of the six huge new 22,500 horsepower drive motors will be undergoing installation, a tricky, heavy construction problem.

The big tunnel is known as "the 40 by 80" for the size of its 40 by 80-foot test section. The current project is adding an 80 by 120-foot test section, large enough for planes with 100-foot wingspans--large enough for full-scale tests with engines running of all aircraft below large commercial transport size. The project also will increase the top speed of air flow in the 40 by 80-foot test section to 345 mph, an increase of 115 mph.

For television, film clips including aerial views of the tunnel structure, drive motor-installation, and significant aircraft tested (including the shuttle) will be available, as will models. The large scale and dramatic shapes of

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the structure will be of interest to newsmen, and will provide excellent photo opportunities for television and newspaper photographers. Since this is a construction site, caution will be called for, as well as reliable shoes.

News reporters attending should come to the NASA gate of Moffett Field, and will be directed from there.

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March 26, 1981

# NASA News

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IMMEDIATE

## SEARING VENUS SURFACE HEAT IS CAUSED BY GREENHOUSE EFFECT

Using NASA's Pioneer-Venus spacecraft data, a team of scientists has virtually proved that the searing 482 degree Celsius (900 degree Fahrenheit) surface temperature of Venus is due to an atmospheric greenhouse effect. Until now the Venus greenhouse effect has been largely a theory.

The work is important to understanding possible adverse effects on agriculture resulting from society's long-term use of fossil fuels.

Greenhouse effect means that the surface temperature is raised when energy in the form of sunlight easily passes through Venus' atmosphere to the surface but has difficulty escaping when converted to longer-wave heat radiation, and is held in by the atmosphere.

The same principle provides much of the heat for nursery greenhouses on Earth.

Calculations, which used Pioneer measurements of atmosphere composition, temperature profiles and radiative heating, predicted Venus' surface temperature "very precisely", says Dr. James Pollack,

- more -

April 2, 1981

NASA's Ames Research Center, head of the Pioneer-Venus radiative heating team. The calculations predict not only Venus' surface temperature, but agree with temperatures measured at various altitudes above the surface by the four Pioneer Venus atmosphere probe craft.

Members of the radiative heating team were Dr. Pollack; Dr. Martin Tomasko, University of Arizona; and Dr. Brian Toon, NASA-Ames. Data from a large portion of the 30 experiments aboard the six Pioneer Venus craft were used in the calculations. The Pioneer Project is managed by NASA's Ames Research Center, Mountain View, CA. The spacecraft were built by Hughes Aircraft Co.

The fact that Venus' atmosphere heat balance can be accurately calculated means the atmosphere heating on Earth caused by burning of fossil fuels also can be predicted. The accuracy of the Venus predictions increases confidence in similar predictions for the Earth.

The main atmosphere ingredient holding in Venus' heat is carbon dioxide. Eighty years of burning fossil fuels on Earth has increased atmospheric carbon dioxide by 15 per cent. Predictions of increased future burning of fossil fuels like coal and oil suggest that the carbon dioxide in Earth's atmosphere could be doubled in 50 years. Researchers point out that resulting heat trapping by carbon dioxide could raise average atmosphere temperatures from 3 to 7° F. This is a very minor effect compared to the inferno of Venus' surface. Nonetheless, such a temperature increase could well cause "incredible havoc," says Dr. Pollack. (During the most severe phases of the Earth's ice ages, average atmospheric temperature drop has been only 15° F.) Examples of major weather changes/ <sup>resulting</sup> from a 2 to 7° F change in average temperatures might be catastrophic differences in rainfall in marginal agricultural areas such as wheat-growing regions of Canada, the

USSR, and the US.

Such temperature changes also might melt a small but important portion of the polar ice caps--enough to raise ocean levels and cause permanent flooding in major coastal cities.

Having calculated atmospheric heating for one planet (which is almost the most extreme case imaginable), calculations of carbon dioxide effects on Earth's atmospheric heat budget should be much easier.

While these predictions of carbon dioxide effects on the Earth's atmospheric temperature may be overstated, Pollack points out, we should find out without delay whether they are or not, and Venus greenhouse data will certainly help. These questions need looking into because the problems are potentially so serious, and mixed up with other human difficulties like the energy shortage, Pollack adds.

Only half of the carbon dioxide so far sent into the atmosphere by human fossil-fuel burning has stayed there. The rest apparently has been absorbed into the oceans. However, ocean absorption effects have been included in the scientists' calculations of carbon dioxide doubling.

Pollack explains that Venus' surface temperature of 900°F is remarkable. The planet is only 30 per cent closer to the Sun than Earth, and with a relatively thin atmosphere like Earth's, its surface temperatures would be around a warm but habitable 100°F.

Earth's existing greenhouse effect heats up our planet's surface some 55°F, while Venus' surface temperature is wrenched upward by 800°F due to the greenhouse effect. This happens despite the fact that Venus currently absorbs less solar energy than the Earth.

Venus' highly reflective clouds bounce back much of its incoming solar energy (sunlight) to space.

Calculations by the Pioneer team, using data from the Pioneer Orbiter and measurements by the four Probe craft, which sampled the atmosphere from top to bottom, have characterised Venus' greenhouse exactly. The team now has established exact amounts of sunlight absorbed at various places in the atmosphere and at the surface.

They have established the role and amount of heat trapping by the various gases and particles in Venus' atmosphere. These include carbon dioxide, water vapor, sulfur dioxide, and various types of cloud particles. Finally, Venus' planet-wrapping haze layer provides a "cap" to the greenhouse, explaining the last 25 to 30<sup>o</sup>F of heat. These calculations in general balanced the amount of sunlight absorbed, with the heat radiated to get the temperature at various points.

"The team was able to produce the actual surface temperature of Venus "very precisely," says Pollack. "We're very gratified."

Water vapor amounts reported by the Russian Venera spacecraft were used in the greenhouse calculations instead of the Pioneer measurements because they fit well with all the rest of the data. The amount of water vapor finally decided on was much less than planetary had been thought possible to produce the required/greenhouse effect. The team found that the remaining heat expected to be absorbed by water vapor was instead absorbed by sulfur dioxide and Venus' heavy clouds.

Carbon dioxide, which makes up 96 per cent of Venus' tremendously massive atmosphere had by far the largest role in trapping heat on Venus. Water vapor and sulfur dioxide also

trapped important amounts of heat, as did the clouds and planet-enveloping haze layer. The calculations included amounts of heat absorption for carbon dioxide in long heat radiation wave lengths that this gas does not normally absorb. However, under Venus' enormous atmospheric pressure, carbon dioxide absorbs heat even at very long wavelengths.

Amounts of heat taken up by the various key absorbers in Venus atmosphere were found to be as follows: carbon dioxide - 55 %; water vapor - 25 %; clouds and haze - 15 %; and sulfur dioxide - 5 %.

The Pioneer Venus atmosphere composition measurements were critical to the calculations. These were, by percentages of the total atmosphere: carbon dioxide - 96 %; water vapor - about 50 parts per million (ppm) in the lower atmosphere (Venera data); sulfur dioxide - about 200 ppm in the lower atmosphere. Cloud depths used were: 30 km (18 miles), and haze layer depth 12.5 km (7.5 miles).

Key Pioneer measurements were: atmosphere composition; detailed properties of cloud particles; vertical profiles of amounts of sunlight absorbed at various altitudes in Venus' atmosphere; and total amounts of clouds and haze around the planet.

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IMMEDIATE

## SPACE SHUTTLE TO BE TRACKED BY AIRBORNE OBSERVATORY

When the Space Shuttle Orbiter Columbia reenters the Earth's atmosphere, parts of its surface will reach temperatures as high as  $1,510^{\circ}\text{C}$  ( $2,750^{\circ}\text{F}$ ). Far below, the eye of a unique telescope will be on the Columbia, attempting to catch an infrared image of that heat.

The Gerard P. Kuiper Airborne Observatory, operated by NASA's Ames Research Center, will be stationed about 60,000 m (200,000 ft) below the Columbia's flight path, waiting to catch the Columbia at a point  $9\frac{1}{2}$  minutes after entry into the atmosphere, which is near the point of maximum heating.

The experiment, called the Infrared Imagery of Shuttle (IRIS), uses the Kuiper's 91.5-cm (36-in) telescope to capture the infrared image. Navigation and tracking must be precise, or the telescope's field of view could miss Columbia as it flies past.

The Kuiper C141 aircraft has some navigational uncertainty, and the Columbia, on its maiden voyage, has some positional uncertainties. These uncertainties make the mission very difficult.

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April 6, 1981

"It's like threading a needle," said IRIS principal investigator Byron Swenson. "The telescope is the eye of the needle and the shuttle is the thread."

Flying out of Hickam Air Force Base in Hawaii, the Kuiper aircraft will take a position parallel to the Columbia's entry track at 12,496 m (41,000 ft) altitude, about one hour before the Columbia's reentry.

As the Columbia passes through the telescope field of view, the telescope detector system will capture the image of the lower and side surfaces of the Columbia for about four milliseconds, recording the information on tape. There will be only one opportunity to record the image. The IRIS experiment will be attempted with each of the first six shuttle flights.

After the flight, the infrared data will be supplemented by orbiter-derived data of velocity, altitude, angle-of-attack, yaw and roll conditions existing during the period of observation by the IRIS experiment, as well as with temperature data recorded on-board Columbia.

Surface temperatures and aerodynamic heating of the orbiter can be determined from the high-resolution infrared imagery. This knowledge will increase understanding of aerothermodynamic phenomena which affect the thermal protection system so crucial to the orbiter.

Analysis of the data involves computer arrangement into a two-dimensional image format, radiometric analysis and detailed comparisons of the aerodynamic heating rates with analytical predictions and ground-based experiment data.

Information from the IRIS experiment will help in the development of improved thermal protection materials and techniques. Ames

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April 6, 1981

Research Center developed the special reaction-cured glass coating of the thermal protection system. Newer materials and better techniques for their manufacture are undergoing continuous testing in Ames labs.

The Kuiper Airborne Observatory, a Lockheed C141 Starlifter aircraft, carries the 91.5-cm (36-in) aperture Cassegrain-type reflector telescope which is installed in an open cavity recessed into the port side of the aircraft immediately ahead of the wing. The telescope can be moved in flight over an elevation range of 35 to 75 degrees. It is capable of tracking celestial objects to an accuracy of less than two arc seconds by use of precision gyroscopes and an active digital tracking system.

The Kuiper Airborne Observatory is operated as a National Facility available to any organization having a valid research objective, much like ground-based observatories. Flying at 12 km (39,000 ft), it is above 85 percent of the Earth's atmosphere and more than 99 percent of the water vapor, the major attenuator of infrared radiation.

The Kuiper has been the source of many significant scientific discoveries -- the rings of Uranus; intrinsic energy sources at Jupiter; sulfuric acid in the clouds of Venus; and powerful far-infrared emission from other galaxies and from our own galactic center.

The aircraft is dedicated to the late Dr. Gerard P. Kuiper, founder and former director of the Lunar and Planetary Laboratory at the University of Arizona. Kuiper played an active role in NASA's early space programs, including the Ranger and Surveyor Lunar missions, the Mercury-Venus mission in 1973 and the Pioneer 10 mission to Jupiter.

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## MAJOR INTERNATIONAL SPACE TELESCOPE BEING SHIPPED TO NETHERLANDS

A new, remarkably sensitive infrared telescope will be shipped today from Boulder, Colorado to the Netherlands for mating with its Dutch-built spacecraft. This telescope is known as IRAS (Infrared Astronomical Satellite), and its purpose is to make the first comprehensive infrared survey of the entire sky, mapping perhaps a million infrared sources, many of them previously unknown. The results of this survey could change our concept of the universe, because infrared light from the stars and other cosmic sources is blocked out by the earth's atmosphere. The telescope will see those numerous sources for the first time. The instrument was built for NASA's Office of Space Science by Ball Aerospace Systems Division, Boulder, Colorado, and its development has been managed by NASA's Ames Research Center, Moffett Field, California. The project is an international joint venture of the United States, the Netherlands, and the United Kingdom. Project management in the U.S. is at the Jet Propulsion Laboratory, Pasadena, California. The telescope is scheduled for launch in August, 1982.

Sky surveys have been a longtime tool of astronomers, providing basic information from which the more complex aspects of the character and evolution of the universe can be studied. The IRAS telescope is expected to provide a wealth of information about astronomical sources, including new and unusual kinds of stars, and perhaps entire infrared galaxies. It should locate thousands of new quasars whose light is 11-12 billion years old and comes from the early universe. Hence, IRAS could provide new generalized evidence about the "big bang" theory and formation of the universe.

The new telescope in space may well find that a far larger part than expected of the universe's energy budget is in the infrared. IRAS will look into the dust-hidden center of our Milky Way galaxy with its possible black hole, and will locate suddenly visible (in the infrared) new asteroids,

invisible cool stars near the Earth, and even could find a suspected far outer planet.

Other areas for IRAS investigations are the processes of star formation and death, origin and replenishment of interstellar matter, exploding and "star-manufacturing" galaxies.

A little more than half of the IRAS effort will go into producing the first high sensitivity infrared sky map and catalogue. The rest of the approximately year-long mission will be devoted to special studies. These might be detailed observations of an infrared galaxy, studies of clusters of galaxies, a "close-to-home" survey of the plane containing the sun's planets (the ecliptic) in search of new asteroids, a possible outer planet, and undiscovered comets. All of these "cool" objects are much more visible in the infrared, which is itself "cool radiation", compared with the visible light from very hot objects like the stars and sun.

On its 900-km (563-mile), sun-synchronous (sun-aligned), 100-minute polar orbit, the ten-foot-high IRAS telescope always will look straight up. IRAS will do two complete whole-sky surveys during its life, sweeping out  $1.5^{\circ}$  of sky with every orbit. On this high orbit, it will be far above the atmosphere with its infrared-blocking water vapor.

The telescope employs remarkable advanced technology. Its focal plane will operate at a temperature of almost absolute zero in orbit, just four degrees above at  $-456^{\circ}$  F. It will be cooled by extremely heat-conductive superfluid liquid helium, the first space use of this material. The entire interior of the telescope will be cooled down to within  $15^{\circ}$  F above absolute zero. An array of 62 infrared detectors in the focal plane will measure infrared radiation in four wavelength bands, centered at 10, 20, 50, and 100 micrometers.

The IRAS spacecraft will weigh 834 kg (1838 pounds). The science payload will weigh 499 kg (1100 pounds). A Delta launch vehicle will launch the telescope into polar orbit, from the Western Test Range, Lompoc, California.

The IRAS program will involve nearly 1,500 scientists, engineers, and technicians from the three sponsoring nations.

### The Telescope

The IRAS telescope optics are a two-mirror Cassegrain design. Infrared radiation from space falls first on the large, concave, primary mirror. It then is reflected upward to the small, convex, secondary mirror which reflects the radiation back down through the cylindrical aperture in the primary mirror

onto the 62 detectors in the focal plane. Also located at the focal plane is a spectrometer provided by scientists from the University of Gronigen, Netherlands.

To eliminate its own heat radiation (infrared), the telescope is super-cooled. It is surrounded by a double-walled cylindrical vessel (a Dewar) filled with 70 kg (154 pounds) of superfluid helium with a temperature of almost absolute zero. The use of special insulating materials and of construction with low-heat-conductive components will limit the effects of heat radiation (infrared) from the Sun and Earth. An even temperature everywhere in the helium vessel is created automatically by the extreme heat conductivity of superfluid helium.

A helium vessel of this size has never been used in space, but rocket flights have shown that a Dewar vessel with superfluid helium will function under weightless conditions.

For maximum measuring accuracy, optical mirrors and detectors must be guarded against contamination. During tests on Earth, the instrument is kept tightly sealed because, with the whole system cooled to near absolute zero, any of the known gases except helium would condense and freeze on these vital components. Contamination just .001 millimeter thick on the optics is enough to cause an incorrect measurement.

An onboard computer in the spacecraft will perform the IRAS mission, responding to instructions from Earth. Two solar panels supply electrical power for satellite and telescope operations.

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## ROBERT T. JONES AWARDED SMITHSONIAN'S LANGLEY MEDAL

Dr. Robert Thomas Jones, senior scientist at NASA's Ames Research Center, recently was awarded the distinguished Langley Medal by the Smithsonian Institution for his "extensive contributions in theoretical aerodynamics, particularly with regard to development of the swept wing, supersonic area rule and, more recently, the oblique wing."

The Langley award has been given to just 16 recipients since it was established 73 years ago. Past recipients include Wilbur and Orville Wright, Colonel Charles Lindbergh and Rear Admiral Byrd. Named for Samuel Pierpont Langley, aeronautical pioneer and third secretary of the Smithsonian, the medal honors "especially meritorious investigations in the field of aerospace science."

Jones discovered the theory of the "simple sweepback," one of the most important discoveries in aerodynamics (swept wings are seen on most jet aircraft today). He is an internationally acclaimed expert on aerodynamics, optics and biomechanics, as well as an applied mathematician, astronomer, inventor, author and violin-maker.

Jones, who never finished college, was awarded an honorary doctorate of science in 1971 by the University of Colorado for his "scientific eminence and his service to society."

(more)

May 15, 1981

He dropped out of college in 1928 after one year at the University of Missouri. Because he found books on aerodynamics more exciting than required freshman texts, he went to work for Charles Fower's Flying Circus, carrying gas cans, patching wing tips and getting paid in flying lessons.

At 19, Jones was working for Nicholas-Beazley Aircraft in his home state of Missouri when he designed a 576-pound race plane, which later was the subject of the first of more than 65 technical papers he has authored.

When the aircraft company folded in 1930, Jones went to Washington, D.C. He got a job as an elevator operator in the House Office Building, where he met Dr. Max Munk, a pioneer in aeronautics who had been a scientist with the National Advisory Committee for Aeronautics (NACA -- NASA's predecessor).

Jones had read Munk's "Fundamentals of Fluid Dynamics for Aircraft Designers." The elevator boy so impressed Munk that Munk gave him an oral exam and enrolled him in graduate courses at Catholic University. Jones studied airfoil theory, vector analysis and relativity theory under Munk in three years of night classes.

Jones' career with NASA began in 1934, when he went to work on a nine-month Public Works Administration assignment at NACA's Langley Memorial Aeronautical Laboratory (now NASA's Langley Research Center) in Virginia.

He stayed on at Langley, and by World War II had published important papers and become well-known in aeronautical circles. Jones' 1944 discovery of the sweepback theory was not accepted by most scientists at the time, but NACA began experiments to test the theory. When the

(more)

May 15, 1981

Allies defeated Germany, U.S. scientists discovered the Germans knew about the effect of sweep and were incorporating it in new aircraft designs.

For his discovery of the sweep effect slender wing theory and other contributions, Jones was given the Sylvanus Albert Reed Award by the Institute of the Aeronautical Sciences in 1946. That same year, he came to work for Ames Research Center.

About that time he became interested in telescopes. He studied geometrical optics, learned the art of grinding spherical mirrors and set up an optical shop in his garage, where he built telescopes and lenses.

Although most of Jones' scientific writings have dealt with lift, drag and fluid flow, he also has written papers about telescopes, interplanetary travel time, relativity and a design for an artificial heart (a fluid flow problem).

In 1963, Jones left NASA to work for AVCO Everett Research Laboratory, where he applied fluid dynamics to the problems of blood flow. Returning to Ames in 1970, he went back to work on his oblique wing concept. An oblique wing research aircraft now is being tested at NASA's Dryden Flight Research Center, Edwards, Calif.

Jones was to discover yet another interest, this one related to the rearing of his six children. When his daughter Patty became a violinist, Jones studied the mechanics and principles of violin-making, fashioning eight traditional violins as well as an electronic instrument.

In 1973, Jones was elected to the National Academy of Engineering and the American Academy of Arts and Sciences. He was honored in 1976

(more)

May 15, 1981

with a cash award from NASA's Inventions and Contributions Board and received the Prandtl Ring Award in 1978 from the German aeronautics society (Deutsche Gesellschaft fur Luftund Raumfahrt), considered the highest honor in the field of fluid dynamics.

A Fellow of the American Institute of Aeronautics and Astronautics, Jones in 1979 was chosen for the award of Honorary Fellow. In 1981 he was elected to the National Academy of Sciences.

Earlier this year, Jones was presented the President's Award for Distinguished Federal Civilian Service, in honor of the many contributions of his 40-year government career.

A native of Macon, Mo., Jones now resides in Los Altos Hills, Calif.

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May 15, 1981

# NASA News

National Aeronautics and  
Space Administration

Ames Research Center  
Moffett Field, California 94035  
AC 415 965-5091

For Release

Peter Waller 415 965-5091  
Susan Frey

IMMEDIATE

Release No. 81-35

PIONEER 10 TO CROSS 'SILVER AU' ON WAY OUT OF SOLAR SYSTEM;  
FINDS HUGE EXTENT OF SOLAR ATMOSPHERE

Pioneer 10, now a little over halfway between the orbits of Uranus and Neptune on man's first trip out of the solar system, has found that the Sun's atmosphere and magnetic envelope "extend an enormous distance--far beyond the point predicted by many scientists," according to J.A. Van Allen, Pioneer investigator.

This discovery means that "if you were living on any other planet, you would find a solar environment surrounding it like that surrounding the Earth. This would include: a constant solar wind, buffets by solar magnetic storms, and in many cases, radiation belts," said Van Allen, of the University of Iowa, who discovered Earth's Van Allen radiation belts.

Pioneer 10 data can be used to forecast that Voyager 2 will find such "solar" conditions during its encounter with the planet Uranus in 1986, he added. The findings also predict similar solar environment conditions for Neptune and Pluto.

-more-

Van Allen and other Pioneer investigators discussed these results at a special celebration of Pioneer 10's crossing of the silver (25th) astronomical unit (AU) from the Sun this year.

(An astronomical unit is the distance from the Earth to the Sun, about 93 million miles, and is the conventional space yardstick for solar system measurements.) On July 26, Pioneer 10 will reach the 25 AU mark or 2,323,895,500 miles (3,739,947,300 kilometers) from the Sun.

As far out as Pioneer 10 now is, at 25 AU, it takes 3 hours and 28 minutes for spacecraft data traveling at the speed of light to reach the Pioneer Operations Center at NASA's Ames Research Center, Mountain View, CA.

The silver AU celebration was a special Pioneer 10 session at the recent annual meeting of the American Geophysical Union in Baltimore.

Aaron Barnes and John D. Mihalov, NASA-Ames; E.J. Smith, the Jet Propulsion Laboratory; J.A. Simpson, University of Chicago; and F.B. McDonald, NASA's Goddard Space Flight Center, along with Van Allen, presented papers.

Pioneer 10 is managed by NASA's Ames Research Center. It was built by TRW Systems, Redondo Beach, CA.

Information from Pioneer 10 proves the Sun's influence extends to at least 25 AU and probably well beyond. The scientists found no clear evidence as yet of a close approach to the heliopause. The heliopause is the border between the Sun's atmosphere and interstellar space, the medium between the stars.

Some scientists had predicted that the heliopause would be found as close to the Sun as 5 AU.

Our Sun is a star, the only star we can study in detail from close up. It is also a star typical of the majority of stars in the universe. Hence the new findings about the character and scale of the Sun's atmosphere and magnetic envelope greatly increase our understanding of other stars, and the environments of any planets they may have, the scientists noted.

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## Ames Research Center

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For Release

Release No. 81-36

IMMEDIATE

### KING NAMED PUBLIC AFFAIRS

### OFFICER AT AMES

Lauren D. King has been named Public Affairs Officer at NASA's Ames Research Center, Mountain View, CA. King was previously public information officer at Ames.

In his new post, he is responsible for NASA public information, educational programs and external relations for Ames and the 11 western states.

King joined NASA's Western Operations Office as information officer in 1962, and came to Ames in 1970. Previously, he had worked on several newspapers in California and Oregon as photographer, reporter, and copy editor. He was in the U. S. Army in Korea and is a graduate of Oregon State University. He was born in 1929 in La Grande, Oregon. He and his wife, Anne, live in San Jose, CA. They have a son and daughter.

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June 26, 1981

# NASA News

National Aeronautics and  
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**Ames Research Center**  
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Susan Frey 415 965-5091  
No. 81-40

For Release: IMMEDIATE

## SATELLITES HELP TO MONITOR CALIFORNIA CROPS

California agriculture is being monitored from space. NASA's Ames Research Center and the California Department of Water Resources are testing the use of satellite imagery to inventory and map irrigated cropland.

During July and August, the middle of California's dry season, anything that shows up as red on Landsat color composite images indicates vigorous vegetation and may have been irrigated, according to Ethel Bauer, California Irrigated Lands Assessment Project director for NASA's Ames Research Center in Mountain View, California.

Irrigated areas can then be separated from natural vegetation, such as that found along streams, through their spatial rather than spectral characteristics. That is, irrigated fields show distinctive shapes (usually blocked) and homogeneous texture as opposed to the irregular shapes of vegetation along stream beds and the mottled texture of forests.

NASA's two Landsat satellites can survey any spot on earth every 18 days. Imagery of the state was chosen from three time periods in 1979: March and April, July and August, and September

-more-

August 11, 1981

and October. A multi-spectral scanner on each satellite records differences in sun reflectance from earth-surface features.

The scanner takes four readings for each 1.1 acre area on the ground based on the intensity of visible and invisible (infrared) light that is reflected. These intensity levels are converted to film and computer compatible tapes at stations on Earth.

Maps indicating which areas were irrigated were drawn from the satellite data. Since agriculture uses 85 percent of the state's water supplies, such maps can help in the Department of Water Resources monitoring of water use.

Currently the department conducts land use surveys, relying on aerial photography and data collected on the ground, that cover approximately one-seventh of the state each year. Thus the entire state is resurveyed about every seven years. A statewide analysis of Landsat satellite data, covering the entire state over one growing season, came within one-half percent of the water department's data.

Besides confirming the department's data, the analysis also helped Ames researchers verify their techniques. "We have been using the Department of Water Resources' ground data to help verify Landsat data," Bauer said. "California has a vast network of good ground data.

"California is a real test of Landsat techniques," Bauer added. "We are trying to augment a very good system as opposed to getting data that we didn't have before. The question now is, can we do it cheaper and/or faster?"

But Landsat is able to do more than confirm existing data. The satellite imagery is now being tested by the water department for use in monitoring early grains and double cropping.

"It's not easy for the Department of Water Resources to monitor the early grains, such as wheat and barley," Bauer said. "They have to estimate because their ground survey is normally in July. The early grains are out by the end of June."

Landsat data covering March through June are being used to catch the early grains. By comparing the data over the three time periods (March/April, July/August and September/October), the department also can tell whether more than one crop has been planted on any given acreage.

"California agriculture is so dynamic that it would be inadequate to look at just one date," Bauer said. "By summing up three timeframes, however, we can obtain a good estimate of total irrigated acreage."

Certain crops have what Bauer calls a Landsat signature. A signature, which is determined by viewing the same area over time, shows distinctive coloring, or spectral reflectance, separating one crop type from another. For example, in the early part of the year, alfalfa and wheat both appear red. But in late May or June, the wheat has dried and appears bright yellow. The irrigated alfalfa continues its red appearance on the satellite imagery. The satellite is now monitoring four counties--Kings, Yolo, Glenn and Butte, to determine how much early wheat is being grown.

More than 200 different crop types exist in California, Bauer said. "Some crops are difficult to distinguish by satellite. At certain growth stages they are hard to tell apart when you drive past them ten feet away." Furthermore, crops covering less than 10 acres are hard to pick up by satellites traveling at 570 miles altitude.

However, Bauer is hoping to be able to monitor 90 percent of the crop acreage. Generally, in each of the 10 hydrologic regions that comprise the entire state, 20 or 30 crops are grown. Typically, approximately 10 of those crops cover 90 percent of the area.

"We're trying to make the problem a little easier by going after those 10 crops," Bauer said. "We do very well if the crop covers a large area. We may do very poorly if the crop covers 2 percent or less of the area."

The project relied on Ames research staff, personnel from the state Department of Water Resources and remote sensing experts from UC-Berkeley, UC-Santa Barbara, and Technicolor Graphic Services. More than 10 million acres were surveyed by the satellite, and 1 1/4 million acres of ground sample data acquired by the California Department of Water Resources were used to verify the satellites' information.

Landsat orbits the earth 14 times each day at an altitude of about 570 miles. The first Landsat was launched in 1972 and, though only expected to function one year, continued providing information until January, 1978. Landsat-2, still functioning, was launched in January, 1975; Landsat-3 was put into orbit March, 1978. A fourth and more technically advanced Landsat is scheduled for launch in mid-1983.

# NASA News

National Aeronautics and  
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**Ames Research Center**

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**IMMEDIATE**

Release No. 81-43

TO EDITORS:

As a result of findings by the several Pioneer-Venus craft, the Venera landers, Mariner, and other work, much more information now exists about Venus than ever before in history.

On November 1-6, a NASA international conference on the Earth's twin planet will be held in Palo Alto, CA, and will draw on the work of virtually all of the world's Venus experts.

This will be a major event in planetary science, and you may want to set aside these dates with a view to coverage. Much of the new Venus information has now been digested, and a number of new general conclusions about the atmosphere, surface, and interior should provide good stories. A comprehensive description of the cloud-hidden planet will result.

The conference is co-chaired by NASA-Ames and the University of Arizona. Arizona will publish a textbook, based on conference papers, which is expected to be the definitive work on the planet for a number of years. Some 500 scientists from the U. S., USSR, and a number of European countries will attend. The Pioneer-Venus spacecraft builders and other organizations also will participate.

This note is for your planning. We will be sending you a program schedule and other details as we get them. We expect to have a series of news events during the week of the conference, but plan news conferences only for definite stories, not daily briefings. The Pioneer-Venus Orbiter has been taking pictures of Venus regularly for more than two years. These views and a variety of other visuals will be available.

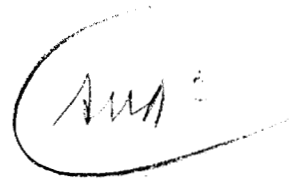
Hotel accommodations are always somewhat tight in the Palo Alto area, and planning is warranted.

8-4-81

# NASA News

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For Release: IMMEDIATE

Release No. 81-44

## VENUS' GENERAL ATMOSPHERE

### CIRCULATION DESCRIBED BY PIONEER

While major questions remain, the overall circulation patterns for Venus' tremendously massive atmosphere (100 times as massive as Earth's) have emerged from a complete analysis of Pioneer Venus spacecraft data.

Venus' predominant weather pattern is the high-speed circulation of the middle and upper atmosphere round and round the planet, from east to west, at velocities up to 225 mph.

Superimposed on these high-velocity, planet-circling winds are lower-speed winds blowing from the equator to the poles (see diagram No. 1). Wind and temperature measurements by the four Pioneer probes widely-scattered over the planet indicate that these meridional winds make up a series of equator-to-pole circulation cells, stacked one on top of the other with each of the upper three cells counter-rotating as gears do (see diagram No. 2). All of the winds in these equator-to-pole circulation loops are driven by the solar

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energy absorbed primarily in Venus' dense, high-cloud layer (the planet's cloud cell). The whole complex of stacked circulation cells carries Venus' solar heat, absorbed near the equator, to the polar regions. Because Venus' rotation is so slow (243 days for one axial rotation), rotation forces do not break up these huge, hemisphere-spanning circulation loops as they do similar ones on the fast-spinning Earth.

These two kinds of circulation, 1) around the planet, and 2) equator to poles, mean that the atmosphere is thoroughly mixed. This means it is about the same temperature and pressure everywhere -- equatorial and polar regions, and day and night sides.

The five Pioneer-Venus probe craft measured the planet's atmosphere from top to bottom in four locations on day and night sides of the planet on Dec. 9, 1978. The Orbiter has been making pictures and other observations of the planet for the past two years and will continue to do so through 1985. All six Pioneer-Venus craft arrived at the planet in December 1978.

The Pioneer Project is managed by NASA's Ames Research Center, Mountain View, CA. The spacecraft were built by Hughes Aircraft Co., El Segundo, CA.

While Venus' atmosphere behaves differently than Earth's, understanding of Venus' "weather" is helping with understanding such Earth weather phenomena as heat trapped by the "greenhouse effect", transport of heat to the polar regions, and interactions between the lower atmosphere and the stratosphere.

Venus' massive, planet-circling winds blow from east to west, the same direction as the very slow retrograde (backward) planet rotation. (Earth winds blow mainly west to east, the same direction that our planet rotates.)

Between altitudes of 20 km (12 mi) and 65 km (40 mi), speeds of these winds range from 50 mph at 20 km altitude to 225 mph at 65 km above the planet.

These winds represent 25 times as much atmosphere mass as the total Earth's atmosphere, but they are only a quarter of Venus' enormously massive atmosphere. At their highest speeds, these winds circle the planet once every four days.

Despite the scale of these high-speed, upper-level winds, three quarters of Venus' atmosphere near the surface is very sluggish. From the surface up to 10 km (6 miles) altitude, wind speeds range from only 2 to 11 mph.

In a general way, the high-speed winds can now be explained by the fact that when Venus' "air" moves upward due to solar heating, it carries some momentum of the solid planet upward, and on successive passes, as the atmosphere circulates globally, the momentum accumulates at the upper levels. The details of this process remain something of a mystery, according to Dr. Gerald Schubert, UCLA, a Pioneer-Venus interdisciplinary scientist, but further analysis may clarify this.

On Earth most solar energy is absorbed at the surface. However, on Venus most of the Sun's energy is absorbed in the planet's mantle of dense clouds at about 50 km (30 mi) above the surface. And the planet's equator-to-pole circulation is driven by this "cloud cell" (diagram 2). Temperature

differences in the cloud cell are the greatest found on the planet, a drop of  $20^{\circ}\text{C}$  between equator and  $60^{\circ}$  latitude, according to Alvin Seiff, NASA's Ames Research Center, Pioneer Venus atmosphere structure investigator. This temperature range and associated pressure differences are comparable, he says, to those found at ground level on Earth. Atmospheric pressure at the altitude of the clouds on Venus happens to be about the same as that at the surface of the Earth.

As noted, Venus' equator-to-pole winds are all much slower than its' round-the-planet winds, and are superimposed on them. The net result is that Venus' winds blow mostly around the planet, but also spiral up toward the poles (diagram 1 and 2).

Winds in the top half of the "cloud cell" circulation loop move toward the poles, and this motion has been measured in the Pioneer cloud pictures, as the winds carry the clouds along. In the bottom half of the loop, Pioneer Probe wind measurements showed that the winds travel from poles to equator. In this cell, as in all such directly driven circulation cells, warmed "air" rises at the equator, spills over toward the poles, descends as it cools and flows back toward the equator, where it is rewarmed and goes around again endlessly.

Above the cloud level is a stratosphere cell, from 65 to 85 km (39 to 51 mi) altitude (diagram 2). This cell is not driven by solar heat, but is geared by friction to the cloud cell, and therefore runs in the opposite direction. Below the cloud cell, from 45 to 40 km (27 to 24 mi) is the

similar sub-cloud cell, also "geared" to the cloud cell and also, therefore, running in the reverse direction to it.

Near Venus' surface, there is believed to be a surface circulation cell in the dense, sluggish lower atmosphere, driven directly by the relatively small amount of solar heat absorbed at the Venusian surface.

Between the surface cell and the sub-cloud cell, 30 to 40 km (18 to 24 mi) altitude, there may be more small cells, which can also be thought of as very large eddies. According to Seiff, these eddies or cells are probably horizontal instead of vertical because the atmosphere is stable, not convectively overturning at their altitudes.

The termination of the cloud cells at the poles seems to result in large-scale "turbulence" in the form of double vortices rotating around each other.

These descending vortices were unexpected, and the evidence for them is two "hot spots" rotating around each other. Seen by Pioneer infrared sensors, such hot spots are explained by Dr. Fred Taylor, Jet Propulsion Laboratory, Pioneer infrared investigator, as the result of lower, hotter levels of atmosphere, made visible by holes in the clouds.

The Pioneer Probe measurements showed that Venus' atmosphere is convectively overturning only within the main cloud deck between 53 and 56 km (33 and 35 mi) altitude, and in a layer below the clouds between 20 and 28 km (12 and 17 mi) altitude, and possibly in a third layer between the surface and 6 km (0 and 3.6 mi).

The rest of the atmosphere appears to be "stable" (not

convectively overturning). In the dense clouds of the upper convective layer, 53 to 56 km (32 to 34 mi) altitude, there also seems to be local convective overturning -- in some ways like thunderstorm convective cells on Earth.

There is evidence of "sloshing" (gravity waves) in Venus' stable layers at various places in the atmosphere -- distantly related to up and down motions of ocean waves, and driven by the rapid passage of the atmosphere from the night side to the day side, and consequent heating as it enters the sunlit hemisphere.

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Diagram No. 1

Venus' predominant atmosphere circulation is the high-speed movement of its middle and upper atmosphere round and round the planet. At the visible cloud tops (shown here), the much slower equator-to-pole winds also cause the clouds to spiral slightly poleward, at the same time that they circle the planet.

# Venus' Atmosphere Circulation

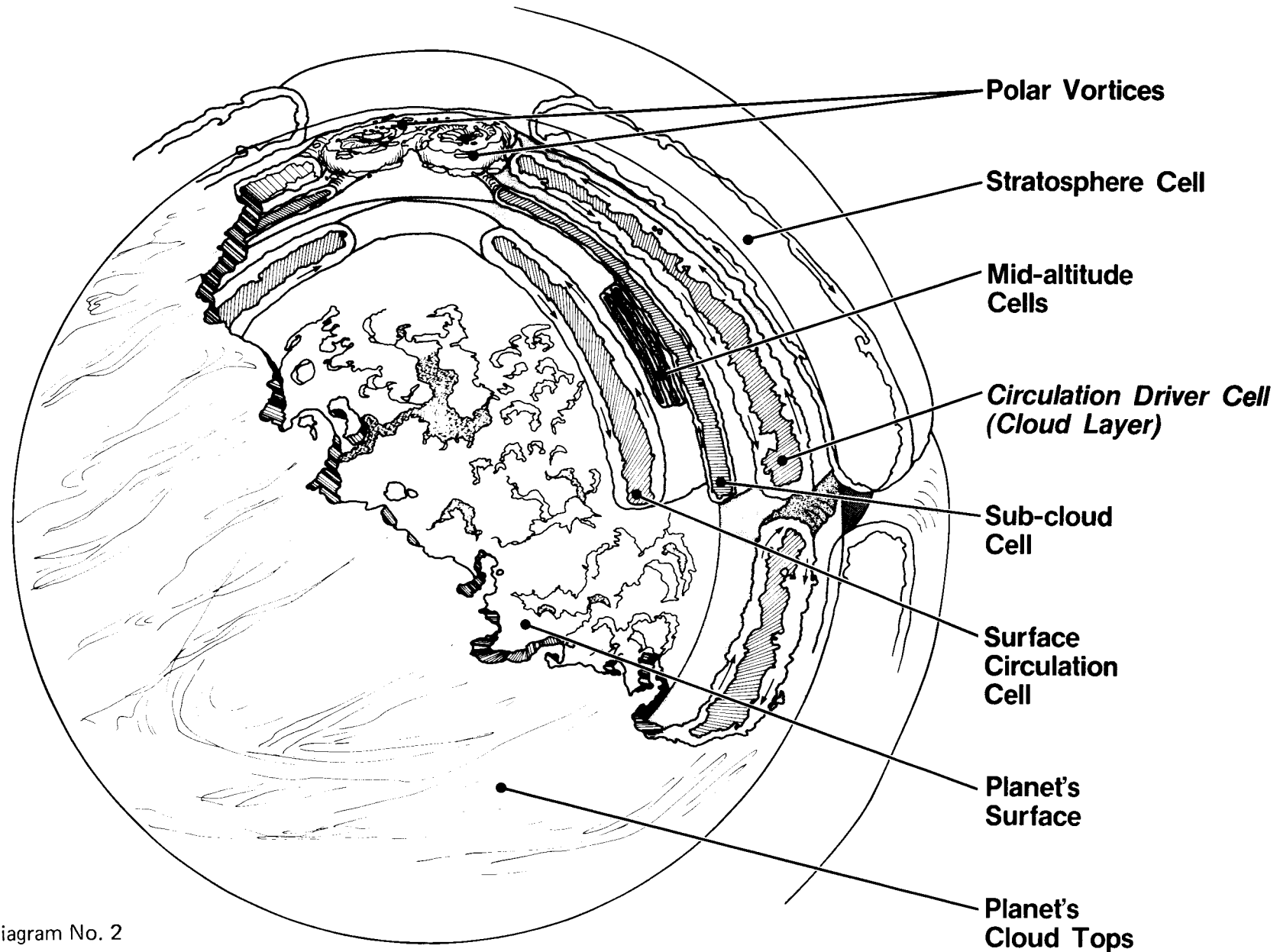


Diagram No. 2

Venus' equator-to-pole atmosphere circulation is shown here. Solar energy is absorbed in the cloud layer (Circulation Driver Cell). The Driver Cell extends from equator to poles. Atmosphere in its upper limb carries heat absorbed in Venus' equatorial regions to the poles. It then descends and returns to the equator to be reheated, rise, and repeat the process. The cloud circulation driver cell drives the other atmosphere circulation cells above and below it, shown here, much like a train of counter-rotating gears. All this mixes Venus' atmosphere thoroughly.

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Susan Frey  
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## NEW TECHNIQUE DEVELOPED TO MEASURE WIND

Researchers at NASA are testing a new technique to measure which way the wind blows. The data collected from a special airborne laser should help scientists better understand storms, regulate air pollution and harness wind energy.

As part of NASA's Severe Storms and Local Weather Research Program, a team of researchers spent this summer flying in Oklahoma, Montana, Colorado and California. On board with the researchers was a Doppler Lidar System, a special laser system built by Raytheon for NASA's Marshall Space Flight Center in Huntsville, Alabama. The aircraft, a Convair 990, is a four-engine jet transport known as the Galileo II flying research laboratory. The aircraft was provided by NASA's Ames Research Center in Mountain View, California.

"Very little is known about what goes on in the clear air around a storm," said Jim Bilbro, the project manager from Marshall Space Flight Center. "We don't know why some die out and others grow. We would like to measure the wind field around the storm to see what is happening."

-more-

The Doppler Lidar System is a whole new concept, a whole new measurement technique, according to Bilbro. The current program is an attempt to establish the credibility of the new system, he added.

"Preliminary findings indicate that the system should be a very powerful tool for meteorological research," said George Alger, mission manager from NASA-Ames Research Center.

The Convair 990 flies at various altitudes near the edge of a storm. The lidar measures the velocity of minute aerosols (pollen and dust). Because these particles are so light, they travel at the same velocity as the wind. The lidar makes two measurements approximately every 1 1/2 seconds, one looking forward and one back, as it flies. The intersection of the readings creates a grid pattern that is analyzed by a computer on board the aircraft. The computer can calculate (based on the original frequency of the beam, the reflected frequency, the speed of the aircraft and other factors) wind vectors. These vectors give the amplitude, direction and speed of the wind in a horizontal plane.

On board the aircraft, the computer gives an instant picture of the wind as it draws little arrows (vectors) showing speed and direction.

Thus researchers, depending on the amount of aerosols in the air, can get a picture of the changes in the speed and direction of the wind in a horizontal slice of the atmosphere anywhere from 300 meters to 20 kilometers from the plane.

Wind measuring technique  
3-3-3

"The laser pulse looks like a pencil that is 300 meters long and 1/4 meter in diameter," Bilbro said.

The laser beam poses no danger to anyone on the ground or in other aircraft.

"This laser system emits energy at levels of 10 to 100 times under the established eye safe level," Alger said. The eye safe level, as established by The American Conference of Environmental Industrial Hygienists, is the amount of radiation an eye can be exposed to without injury.

The lidar system was used this summer in conjunction with the National Severe Storms Laboratory in Oklahoma and the Cooperative Convective Precipitation Experiment (CCOPE), based in Montana. CCOPE, supported by a number of universities and government agencies, is designed to study how nature produces rain, a question particularly important to drought-prone areas such as the High Plains in the West.

Data collected from the summer tests will be compared to data collected from other measurement systems, such as ground radar towers and balloons, to test the accuracy of the new technique. The project scientists, headed by Dr. George Fichtl from NASA-Marshall Space Flight Center, plan to combine data from all available sources to provide meteorologists with a more complete picture of what happens during a storm.

If the new technique is accurate, it will greatly enhance traditional measurement systems.

"You have to guess what happens in between stationary radar towers," Bilbro said. "It's easy to miss gusts of wind."

And, in many areas, including the Central Valley in California, there are few stationary towers. With the airborne system, in a couple of hours the computer provides an overview of the wind pattern for the entire valley.

Wind speed and direction also are important to meteorologists who must monitor air pollution. The aircraft recently flew past various mountain passes in California to determine what happens to polluted air that is created in the San Francisco Bay Area and Los Angeles regions.

"Air pollution is a severe problem in the Los Angeles area," said Charles Unger, state air pollution research specialist. "We need to know what happens to the pollutants-- what are the sources, where do they go, how concentrated are they, who do they impact. We need to know if the air is going to stagnate or move."

Unger is hoping that data from air balloons and ground radar systems together with the information from the airborne laser system will help the state Air Resources Board be able to better predict when to restrict agricultural burning and when to rely on emergency pollution control measures such as switching from oil to natural gas.

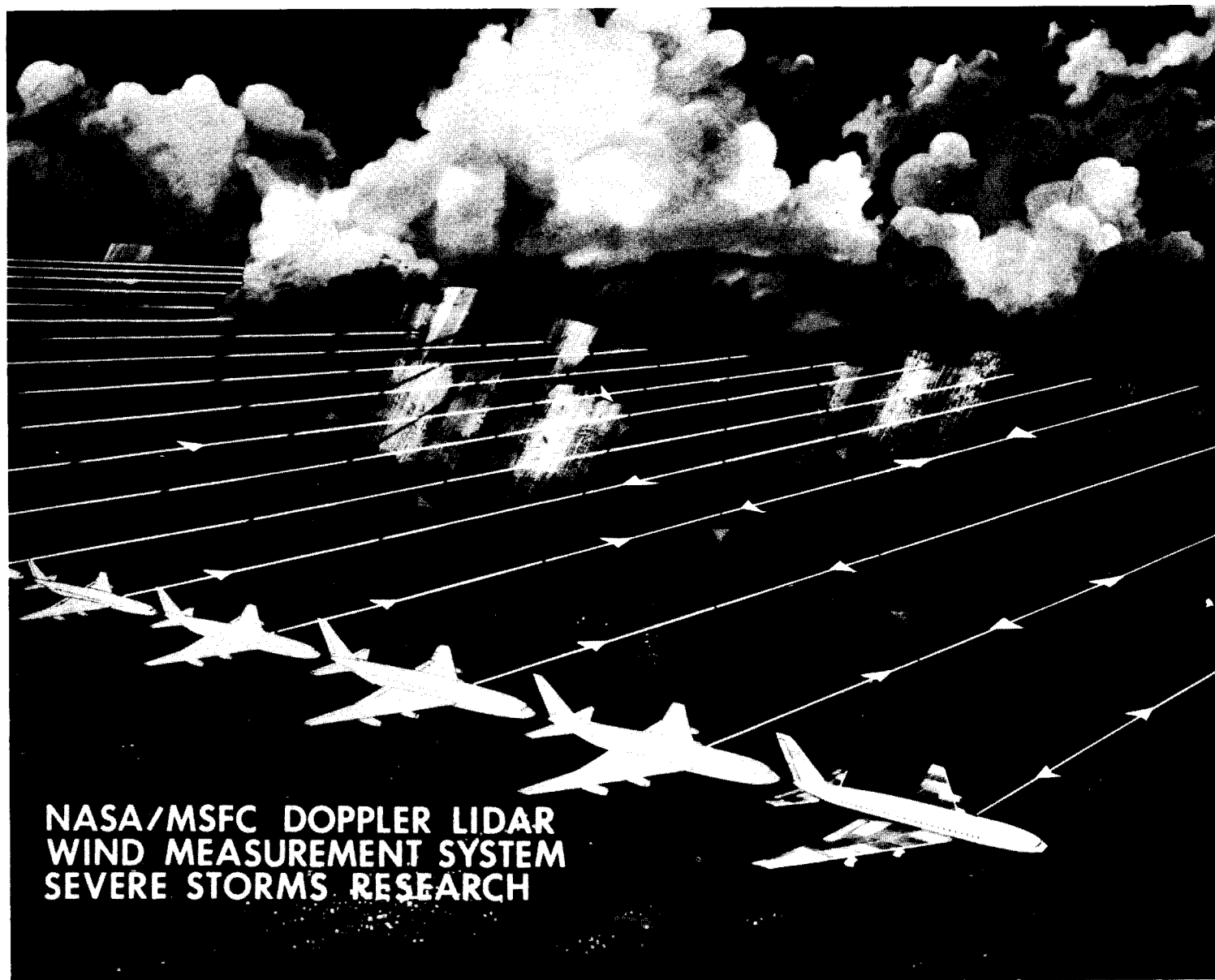
The plane also flies low enough to gather data on the best location for wind turbines. Data of this type was

Wind measuring technique  
5-5-5

gathered at the San Gregonio pass near Los Angeles.

Southern California Edison, a utility company that has a wind turbine in this area, is interested in the results of this data.

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By sending an airborne laser into the air around a thunderstorm, scientists, based on the reflection of the beam from tiny particles in the air, hope to learn more about how storms form and grow.  
(Photograph available from Public Affairs Office, Ames Research Center, Mountain View, California 94035.)

# NASA News

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## Ames Research Center

Moffett Field, California 94035  
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For Release: IMMEDIATE

### DEVICE HELPS BRAIN-INJURED CHILDREN LEARN TO CRAWL

At 4 years, Andrew took 16 hours to crawl one foot (30 centimeters). Francesca, at 10 years, in eight hours could crawl only 13 feet (approximately 4 meters).

Andrew and Francesca have brain injuries. The problems of weight-bearing and friction, caused by gravity, often prevent brain-injured children from being able to carry their own weight.

But Andrew and Francesca were given a second chance. A special device, created by Hubert ("Vic") Vykukal at NASA's Ames Research Center, Mountain View, California, reduces the barrier of friction, thereby giving certain disabled children a chance to reprogram their brains to crawl. (Vykukal had developed frictionless devices for NASA to simulate the motions of satellites in space.)

Andrew, after spending one month on the device, was able to crawl 16 feet (approximately 5 meters) in 25 minutes on his own. Francesca, after seven months, could crawl 140 feet (43 meters) in four hours.

-more-

The Vehicle for Initial Crawling, or VIC device (named for its developer), consists of a rounded piece of plywood large enough to support the child's torso. Three aluminum discs are fastened to the bottom of the plywood, allowing the device to slide along a formica floor similar to the movement of a puck in an air hockey game. The air-bearing surface is created by pumping air through holes in the aluminum discs. Straps attached to the device are placed over the child's shoulders, restraining him and, at the same time, causing the device to move with the child.

The crawling aid is close to the floor, giving the sensation of being on the floor. The child's legs and arms are free to move randomly. When the child makes a movement that causes him to move forward, he receives positive feedback as the device floats along the frictionless surface. This constant and immediate feedback of information to the brain encourages the child to repeat the movement, eventually recreating the normal neurological connection between the brain and the muscles, which was impaired by the injury.

As the child travels farther and farther on the device, he develops his arm and leg muscles as well as coordination. Once he can crawl 300 meters (330 yards), he is then put on the floor alone, without the device. The child then switches back and forth, first using the device and then crawling on his own. Eventually, he no longer needs the device at all.

"If the device does what it is supposed to do, it eliminates itself," said Richard Norton, senior technical coordinator for The Institutes for Achievement of Human Potential in Philadelphia, Pennsylvania. The Institutes asked NASA to help design a crawling device when other aids available to the handicapped were not helping children like Andrew and Francesca.

The crawling device is used as part of an overall rehabilitation program developed by the Institutes. Currently nine children are using the crawling aid: one each from Denmark, India and Japan, three from Italy and three from the United States. Three children have graduated from the device. Fifty devices, costing \$110 each, have been built by a contractor for the Institutes.

"At least thousands of children could potentially benefit from the device," Norton said. "But we don't expect it to solve the problems of all immobile children."

Norton said the Institutes are discovering that the device is more appropriate for flaccid, rather than rigid, spastic handicapped children.

"It's too early to say which children would definitely benefit," he said.

One child that has benefitted from the device is Bradley, a 3 1/2-year-old from Lantana, Florida.

Bradley started on the device last April, spending 4 1/2 hours a day on the crawling aid. At first the hiss of the air passing through the aluminum discs frightened him, but then he began to enjoy his new-found freedom.

"He laughs and he thinks it's a lot of fun," said his mother. "He seems to enjoy it most of the time."

Bradley's parents had tried several other techniques, including an inclined plane, to encourage their son to crawl. He could crawl on the plane, but when they put him on the floor he would not move.

"Nothing was working," his mother said. "Now he's a lot stronger. He can hold his head up really well. His little legs have shape now. And he's starting to use his arms."

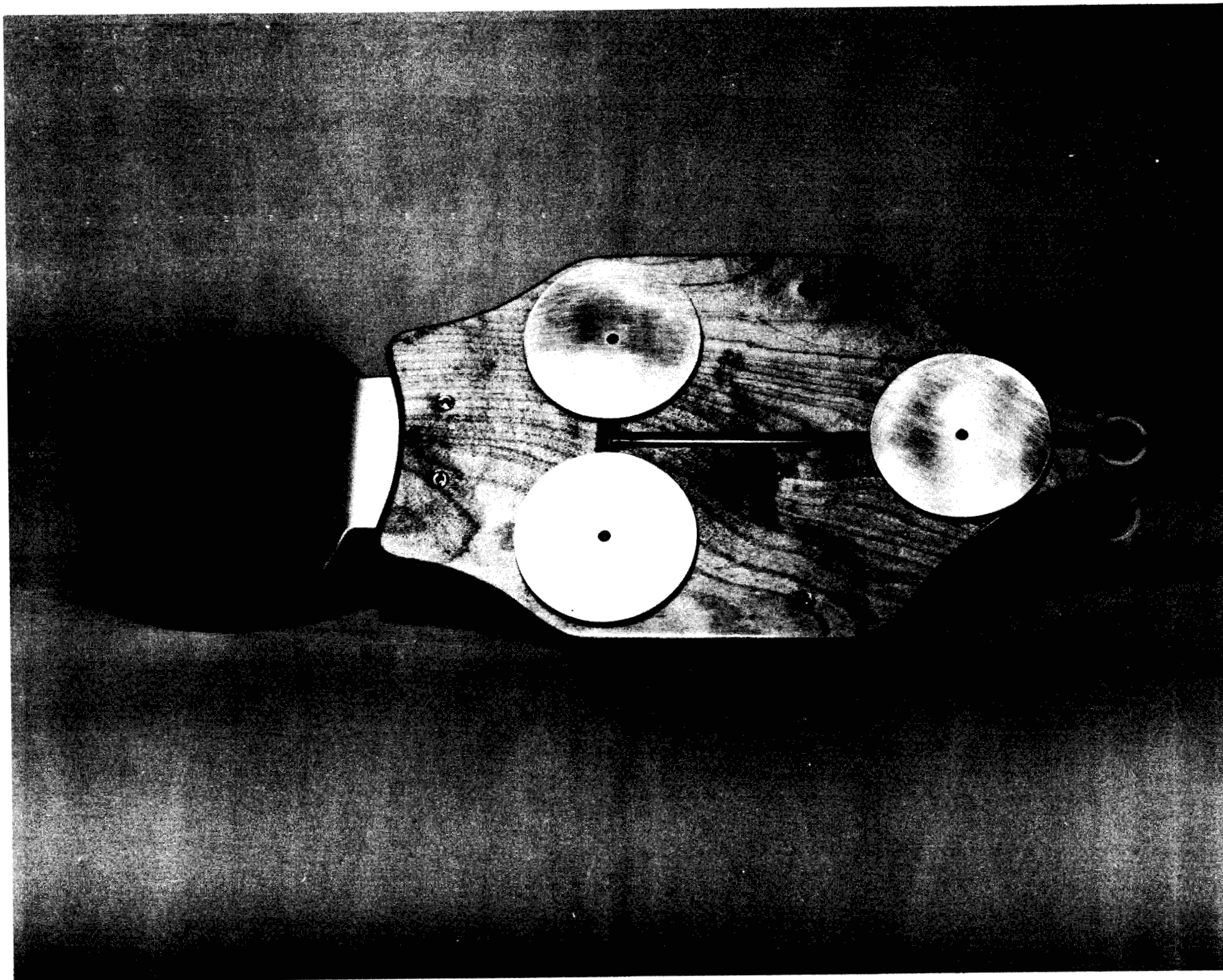
Bradley passed the 300-meter mark on the device in mid-July. He is now able to travel 4 3/4 feet (approximately 1 1/2 meters) in 10 minutes on his own. He was only able to move inches before.

Knowing that children like Bradley are now able to crawl because of his work is rewarding for Vykukal, who spends most of his time developing space suits for NASA.

"It's the most productive thing I've ever done," he said. "If I can make one kid self-sufficient, there's no dollar value on that."



Child learns to crawl on Vehicle for Initial Crawling (VIC) device. Air is pumped through the hose, allowing the device to float on the formica floor like a puck in an air hockey game (Photo is available through Public Affairs, Ames Research Center, Mountain View, California 94035).



The underside of the Vehicle Crawling (VIC) device. Air is pumped through the aluminum discs, reducing friction (Photo is available through Public Affairs, Ames Research Center, Mountain View, California 94035).

# NASA News

National Aeronautics and  
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AC 415 965-5091

X  
91+23

Susan Frey 415 965-5091  
No. 81-50

For Release IMMEDIATE

## AERIAL PHOTOGRAPHY USED TO SPOT CLOGGED DRAINAGE LINES IN IRRIGATED CROPLANDS

Researchers are using color-infrared photography to help California Imperial Valley farmers spot clogged drainage lines in irrigated croplands. The techniques being tested should be useful in other irrigated areas such as Europe where farmers rely on similar drainage lines.

Irrigated farmlands can become less productive due to salts deposited by evaporated water. In the Imperial Valley, an intricate system of drainage lines, located six feet underground, is used to flush out saline water and control the water table below the root zone.

These drainage lines can get clogged because of chemical, bacterial or physical activity, preventing the removal of the saline water. Researchers from the federal Department of Agriculture (USDA) and NASA's Ames Research Center in Mountain View, California, are using aerial color-infrared photography to try to pinpoint these clogged lines before the crops are damaged.

If a clogged drain is discovered before there is any damage to the crops, the drain can be unclogged by using high pressure jet cleaning devices and the crop saved.

-more-

September 23, 1981

NASA aircraft photographed the same drainage lines four times over bare soil last November, five times last June, and once in August, when the crop had reached maximum growth. By comparing the photographs over these time periods, the scientists will be able to detect a pattern of parallel streaks, indicating areas that are drying. A clogged drain will cause a break in this pattern.

According to project scientists, the goals of the program are to determine how often to survey, what time of day to survey, how high to fly the plane, what type of sensors to use, and whether to survey when there is bare soil or a crop canopy.

Preliminary findings indicate that "the higher we fly the better," said John Millard from NASA-Ames Research Center. Infrared photography appears to be the best sensing method. The remaining questions should be answered over the next six months as the data is analyzed.

Once these questions are answered, NASA and the USDA hope to turn the work over to private aerial photography firms that can be commissioned by local farming organizations.

The project scientists from USDA are Luther Grass from Brawley, California and Paul Nixon from Weslaco, Texas.

-end-

September 23, 1981

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Susan Frey 415 965-5091  
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## SATELLITE DATA USED TO HELP LOCATE POWER TRANSMISSION LINES

Pacific Gas and Electric Company (PG & E), which services northern and central California, is using satellite data to help decide the often controversial question of where to locate high voltage transmission lines.

In the prime agriculture country of California's Central Valley, the utility is concerned about the impact the transmission lines will have on agricultural production. Practically all transmission lines in PG & E service areas must cross some type of farmland.

The impact of transmission lines routed through certain crops is greater than through others. The costs of growing "processing tomatoes" are extremely high, according to William Newland, a digital analyst with Technicolor Graphic Services, a contractor for NASA's Ames Research Center in Mountain View, California.

"If PG & E were to run its lines through these tomato fields, the cost of compensating farmers for acreage taken out of production is usually greater than would be the case, for instance, of crossing a grain field," Newland said. "Grapes are another crop type that PG & E would like to have mapped. Because grape vines grow on wire trellises, they generally must be grounded if the trellis wires are parallel to a high voltage transmission line."

\*-more-

September 23, 1981

PG & E is using the satellite data to help evaluate the alternative routes for a transmission line between two substations in the San Joaquin Valley.

By using data from Landsat satellites now in orbit, the major crop types that interested PG & E--cotton, tomatoes, orchards, vineyards and grains--were identified in that area. A detailed land cover image has been generated using Landsat data.

"Because the satellite covers such a wide geographic area, we were able to acquire data that covered all of our alternative corridors," said PG & E's Greg Thornbury, who is directing a study of Landsat for use in transmission line siting studies. "It provides a relatively easy way to compare the alternatives within this farming area."

Each of NASA's two Landsat satellites can survey any spot on earth every 18 days. A multi-spectral scanner on each satellite records differences in sun reflectance from earth-surface features. The scanner takes four readings (four spectral bands) for each 1.1 acre area on the ground based on the intensity of visible and invisible (infrared) light that is reflected. These intensity levels are converted to film and computer compatible tapes at stations on Earth.

Landsat data from May, July and August, 1979, were used. Supplied with ground truth data collected by California's Department of Water Resources and PG & E for the Fresno region, the analysts digitized one-mile by one-mile segments containing the crops PG & E wanted to identify and extracted information based on crop cover types. They then determined signatures for these cover types.

Satellite data  
3-3-3

A signature, which is determined by viewing the same area over time, shows distinctive coloring, or spectral reflectance, separating one crop type from another. The analysts also indicated the corridor boundaries and urban areas on the completed land cover image.

Besides identifying agricultural land cover, creating a land cover image, and determining the feasibility of the alternative transmission line corridors, the project directors will use the information collected to evaluate the future of Landsat data for similar projects.

"The project was a foot in the door for using Landsat," said Thornbury. "It was a fairly well-defined application for corridors that were already established."

PG & E plans to go before the Public Utility Commission with the corridor location proposal. David Sinnott directed the project for NASA-Ames Research Center.

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September 23, 1981

# NASA News

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Sept 15  
X

Susan Frey 415 965-5091

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Release No. 81-52

## FINDINGS SUGGEST NEW THEORY ON ORIGIN OF SOLAR SYSTEM BODIES

Two scientists at NASA's Ames Research Center, Mountain View, California, have contributed significantly to changing scientific thinking regarding the origin of the solar system.

Previously, the solar system was thought to have originated from part of a huge, thin and cold cloud of interstellar matter that contracted into a more dense uniform cloud of hot gases and dust called the solar nebula. As the solar nebula cooled, mineral grains formed by condensation. The dust and grains aggregated into small, solid bodies; and these so-called planetesimals were consolidated into the planets, moons, comets and asteroids. According to this theory, the first formed planetesimals of the solar system should contain roughly the same proportions of the rock-forming elements as are found in the Sun.

Earlier studies found such a similarity in a special class of meteorites called carbonaceous chondrites, once considered by scientists to be primitive or unchanged examples of these first formed planetesimals.

But recent findings of the two Ames researchers revealed that these chondrites were not primitive but in fact had gone through chemical changes.

-more-

September 25, 1981

The findings by Dr. Theodore Bunch and Dr. Sherwood Chang open the doors to new ideas about the origin of these meteorites and, therefore, about what happened in the earliest stages of the origin of the solar system.

The rocky pieces of matter that hold the clues to the origin of the solar system are called carbonaceous chondrites because they contain the element carbon, one of the building blocks of life. They also contain other building blocks--hydrogen, nitrogen and oxygen--and complex organic molecules. They are among the oldest rocks yet discovered, some being 4.65 billion years old.

"They are like archaeological artifacts," Chang said. "Rather than reconstructing cultures, we are trying to reconstruct the origin of these bodies. By doing this, we can begin to reconstruct the origins of the solar system itself."

The researchers found at least three different kinds of clays in the carbonaceous chondrites. The conventional theory hypothesized that these clays formed by reactions between gas and dust in the solar nebula prior to consolidation into small bodies. However, the clays show no evidence of this gas/dust origin. Instead, evidence indicates they formed in ways similar to those of some clays on Earth. (In some Earth environments, water reacts with some water-free minerals to form clays. The water dissolves and transports some minerals away, leaving clay minerals in their places.) These sorts of processes could only have occurred on the parent body of the meteorite (the body the meteorite broke away from)--perhaps on a comet or asteroid--and could not have occurred in the solar nebula gas/dust cloud.

The three different clays also had three different chemistries.

If the solar nebula theory were true, the clays should have more or less a uniform chemical composition. The differences in the clays could be readily explained, however, by the action of water on the minerals in the surface of a small body.

The two researchers now believe the carbonaceous chondrites probably broke away from asteroids or comets after this process had taken place. Thus the chondrites are not unchanged, primitive samples of the past.

This raises the possibility that the water and some of the water-soluble material, including organic compounds, in these meteorites were originally formed in interstellar space before the origin of the solar system. (This possibility requires that they were never evaporated in the solar nebula and managed to survive the processes of consolidation.)

Thus, scientists, through the study of carbonaceous meteorites, may be able to look backward in time and determine what was occurring in interstellar space before the solar system was beginning to form, more than 4 1/2 billion years ago.

"The mystery gets bigger as you expand your parameters," Bunch said.

"These findings liberate people from thinking in an unnecessarily constrained way about the origins of these bodies," Chang said. Now scientists can construct new models and test them rather than trying to fit data to conventional theory, he added.

Bunch and Chang suggest a new model labelled the cosmic raisin muffin model. In this model, when the solar system was forming, the bodies that aggregated at great distances from the Sun in the very low temperature regions--possibly comets--were composed mostly of ice mixed with rocky material and dust, like

raisins in a muffin. Nearer the Sun, as close as the outer regions of the asteroid belt, the meteorites formed. They were made of mostly rocky matter with chunks of ice imbedded in them like raisins.

In many of the carbonaceous chondrites, the clays surround small regions of unchanged, relic material. The two scientists theorize that the parent body, aggregated from both rocky and icy building blocks, was heated, causing the ice to melt and the water to react with rock minerals forming the clays. For some reason, perhaps a cooling of the parent body or insufficient water, alteration of the rocky matrix was incomplete, leaving relic islands of rock.

Work by other researchers support the new model. Scientists discovered the decay products of aluminum 26, a radioactive isotope of aluminum, in carbonaceous chondrites. (An isotope of an element contains the same number of protons, but a different number of neutrons, giving it a different atomic weight.) It is possible that the heat caused by the decay of this isotope could have melted the ice in bodies consolidated in the low temperature regions of the solar system. Chemical reactions involving the resulting water could have formed the clays discovered in the carbonaceous chondrites.

Bunch and Chang also theorize that during the aggregation of solid matter into asteroid-sized bodies (tens to thousands of kilometers in diameter), the associated collision of building blocks with the growing bodies could have produced enough heat to melt the ice.

Bunch and Chang, who recently received the H. Julian Allen Award given by NASA's Ames Research Center for the best scientific or engineering paper authored by Ames employees, plan to continue their studies of meteorites to accumulate more data.

"We have to search for a few clues here, a few clues there," Bunch said. "We are like detectives. The more data we collect, the more able we will be to test assumptions, draw conclusions or say 'that's nonsense.'"

The two scientists plan to expand their study to include interplanetary dust, which may be derived from either comets or carbonaceous chondrites.

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September 25, 1981

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## First International Conference

### On Venus, November 1 to 6

The first international conference on the Venus environment will be held at Hyatt Rickey's in Palo Alto, CA, Nov. 1 to 6, 1981.

As a result of recent findings by the several Pioneer Venus craft, the USSR Venera landers, Mariner, and other work, more information exists now about Venus than ever before. Scientists say that much of this new data is well understood, and the conference should produce a comprehensive description of Venus, the Earth's closest and twin planet.

Attendees at the five-day conference will include virtually all of the world's Venus experts. Of the 118 presentations, 18 will be papers by authors from France, Germany, the USSR, England, Italy, India, Israel, and Mexico. Five of the scientists attending will be from the USSR. A total of 14 of the 118 presentations are invited papers, 72 are contributed papers, and 32 will be poster talks tied in with week-long exhibits.

Subjects to be covered are: Venus' surface and interior; and the composition, structure, and origin of its atmosphere. Scientists also will discuss motions, clouds, and thermal balance

(more)

of Venus' atmosphere, plus the planet's ionosphere and solar wind interactions. Typical of expected "new looks" at Venus is the first survey of density distribution in the crust, comparisons of this with topography, and discussions of Venusian plate tectonics or lack thereof. Other examples are: many new pictures of the planet, and the first movie of rotation of Venus' clouds.

The conference is co-chaired by NASA's Ames Research Center, Mountain View, CA, and the University of Arizona, Tucson. Arizona will publish a compendium textbook, based on the conference papers, which is expected to be the definitive work on the planet for a number of years. Some 500 scientists from the U.S., USSR, and Europe are expected to attend. Following the conference, a special issue of Icarus will be devoted to the papers.

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Jennifer Seymour 415-965-5091

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IMMEDIATE

Release No. 81-56

## BIOLOGY EXPERIMENT PLANNED FOR THIRD SHUTTLE FLIGHT

The third flight of NASA's Space Shuttle, scheduled for launch no earlier than January 1982, will carry the first biology experiment designed for Space Shuttle flight.

Managed by Dr. John Tremor of NASA's Ames Research Center and engineer Ronald Mancini, in conjunction with principal investigator Dr. Joseph Cowles at the University of Houston, the experiment will study the effect of gravity on the formation of lignin in plants. Lignin is the woody substance that gives plants their structural stability.

By watching how seedlings grow in the microgravity environment of space, scientists expect to learn more about lignin synthesis and how wood is formed.

Tremor and other scientists believe that the plants will grow upward in response to the attraction of the growth unit's artificial sunlight, despite a lack of gravity. But as roots are less responsive to light, scientists are unsure how the roots will grow.

(more)

October 28, 1981

"It may be that the roots grow virtually in any direction while the sprouts turn towards the light regardless of the germinating seeds' original position," says Tremor. "We've never been able to maintain a zero-gravity environment long enough to run such a test, so it's hard to really say what we expect. However, the Russians have reported that shoots and roots grown under weightless and dark conditions have grown along the lines determined by the seeds' original placement on the medium."

Dr. Cowles hypothesizes that in space plants will respond to the lack of gravity by manufacturing less lignin. Regulating lignin production has significant economic value. Although lignin is vital to producing the wood of trees, for instance, it is considered a nuisance in some applications; it must be removed before conversion of certain wood products into paper and plastics, and it competes with food production in many plants.

This information may also someday be useful to space colonizers who will need to know of plant growth patterns under weightless conditions and how to maximize the food they can grow.

The experiment itself will occur in a breadbox-sized Plant Growth Unit containing six 25 centimeter-high (10-inch)-high Plant Growth Chambers which resemble thin, rectangular terrariums.

The six receptacles, built from aluminum and a special heat-resistant poly-carbonate material, will house two rows of eight seeds each, in sandwiches of moist sponge and filter paper. There will be oat and bean seeds and pine seedlings which have already been germinated (pine sprouts take more time to germinate than the Shuttle mission will provide).

(more)

October 28, 1981

During the Shuttle's eight-day sojourn in Earth orbit, the six chambers will receive 14 hours of artificial sunlight from sunlamps each day.

"When the Shuttle lands," says Tremor, "the sprouts will be taken out for examination immediately -- possibly even before the astronauts are out."

The orbiting greenhouse will be closely monitored; researchers will be able to tell whether growth directions varied under light or nighttime conditions and thermostat control will guard against possible fluctuations in the spacecraft temperature.

Information will focus on changes in growth patterns, and on the relationship between growth and lignin production.

Construction of the NASA Ames Plant Growth Unit, which has been specially designed to meet the weight, space, power and safety requirements of Space Shuttle payloads, will be completed in October 1981.

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October 28, 1981

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Release No. 81-63

IMMEDIATE

## NASA SELECTS GENERAL ELECTRIC FOR INTEGRATION SUPPORT SERVICES

NASA's Ames Research Center, Mountain View, Calif., has selected General Electric Co., Space Systems Division, Sunnyvale, Calif., for final negotiations of a contract for integration support services for the proposed Numerical Aerodynamic Simulator.

The proposed Numerical Aerodynamic Simulator, a specialized supercomputer currently being studied, would assist in the research and development of new aircraft and other flight vehicles, and do research in such fluid flow areas as meteorology, gas dynamics and computational chemistry. The proposed new data processor may be 40 times faster than existing supercomputers, with a high speed memory 60 times larger than the current generation of supercomputer.

The contract will be a cost-plus-award-fee with a proposed estimated amount of \$6.7 million for the basic 28-month contract and a first 12-month option period, and will begin after selection of a contractor for development of the Numerical Aerodynamic Simulator.

-more-

November 17, 1981

The contractor will provide personnel and materials necessary to support program management, project control, processing system support, test and integration, facility support, and operations support. The work will be performed at Ames Research Center.

The unsuccessful bidders are Hughes Aircraft Co., Culver City, Calif., and Computer Sciences Corp., Mountain View, Calif.

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**IMMEDIATE**

R. T. JONES, SWEEP-WING DISCOVERER

WINS CONGRESSIONAL EXCALIBUR AWARD

Robert T. Jones, inventor of the swept-back wing, basic to all of today's high-speed aircraft, has been named winner of the Excalibur Award, an honor presented by the United States Congress. Jones is a senior scientist at NASA's Ames Research Center, Mountain View, CA, near San Francisco. He is an internationally acclaimed expert on aerodynamics, optics and biomechanics, as well as an applied mathematician, astronomer, inventor, author, and violin maker. Jones will receive the award Wednesday, Dec. 9, at the Capitol Building, Washington, D. C., 9:30 a.m. EST.

The Excalibur Award is presented several times a year, and recognizes outstanding achievements by federal civil servants.

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Among other objectives, it is intended to increase public awareness of contributions by government workers, and to "counter negative views of government common today." Recent recipients have been experts in arctic survival, kidney dialysis, and electrical engineering.

Jones has provided a variety of innovations in aeronautical science, leading to the era of high-speed flight. His papers Theory of Simple Sweepback, The Supersonic Area Rule, and The Independence Principle (for three-dimensional boundary layers) were essential to development of supersonic flight of commercial jets and military jet aircraft.

Recently, he has developed the Oblique Wing design, in which an entire rigid straight wing pivots on the fuselage, the two behaving like a huge pair of scissors. The single, rigid wing is straight-across for takeoff and other low-speed flight, but is swung to a hard-to-believe highly oblique angle for high-speed flight. This design has important potential advantages in fuel economy, noise abatement, landing vortices and operating flexibility because it can fly with maximum efficiency at both low and high speeds (up to mach 1.4, low-speed supersonic) simply by pivoting the wing. Especially in today's fuel-expensive environment, the Oblique Wing may well emerge as the optimum design approach for high-speed, long-range transport aircraft, since just by pivoting the wing it

can provide the greatest fuel efficiencies for all parts of the flight. This design has had two successful flight tests.

Jones never finished college, though he received an honorary doctorate of science in 1971 from the University of Colorado. He dropped out of college in 1928 after one year at the University of Missouri. Because he found books on aerodynamics more exciting than required freshman texts, he went to work for Charles Fowler's Flying Circus, carrying gas cans, patching wing tips and getting paid in flying lessons.

At 19, Jones was working for Nicholas-Beazley Aircraft in his home state of Missouri when he designed a 576-pound race plane, which later was the subject of the first of more than 65 technical papers he has authored.

When the aircraft company folded in 1930, Jones went to Washington, D.C. He got a job as an elevator operator in the House Office Building, where he met Dr. Max Munk, a pioneer in aeronautics who had been a scientist with the National Advisory Committee for Aeronautics (NACA - NASA's predecessor).

Jones had read Munk's "Fundamentals of Fluid Dynamics for Aircraft Designers." The elevator boy so impressed Munk that Munk gave him an oral exam and enrolled him in graduate courses at Catholic University. Jones studied airfoil theory, vector analysis and relativity theory under Munk in three years of night classes.

Jones' career with NASA began in 1932, when he went to work on a nine-month Public Works Administration assignment at NACA's Langley Memorial Aeronautical Laboratory (now NASA's Langley Research Center) in Virginia.

He stayed on at Langley, and by World War II had published important papers and become well-known in aeronautical circles. Jones' 1944 discovery of the sweepback theory was not accepted by most scientists at the time, but NACA began experiments to test the theory. When the Allies defeated Germany, U.S. scientists discovered the Germans knew about the effect of sweep and were incorporating it in new aircraft designs.

For his discovery of the sweep effect and other contributions, Jones was given the Sylvanus Albert Reed Award by the Institute of the Aeronautical Sciences in 1946. That same year, he came to work for Ames Research Center.

About that time he became interested in telescopes. He studied geometrical optics, learned the art of grinding spherical mirrors and set up an optical shop in his garage, where he built telescopes and lenses.

Although most of Jones' scientific writings have dealt with lift, drag and fluid flow, he also has written papers about telescopes, interplanetary travel time, relativity and a design for an artificial heart (a fluid flow problem).

In 1963, Jones left NASA to work for AVCO Everett Research Laboratory, where he applied fluid dynamics to the problems of blood flow. Returning to Ames in 1970, he went back to work on his oblique wing concept. An oblique wing research aircraft now is being tested at NASA's Dryden Flight Research Center, Edwards, Calif.

Jones was to discover yet another interest, this one related to the rearing of his six children. When his daughter Patty became a violinist, Jones studied the mechanics and principles of violin-making, fashioning eight traditional violins as well as an electronic instrument.

In 1973, Jones was elected to the National Academy of Engineering and the American Academy of Arts and Sciences. He was honored in 1976 with a cash award from NASA's Inventions and Contributions Board and received the Prandtl Ring Award in 1978 from the German aeronautics society (Deutsche Gesellschaft fur Luftund Raumfahrt), considered the highest honor in the field of fluid dynamics. A Fellow of the American Institute of Aeronautics and Astronautics, Jones in 1979 was chosen for the award of Honorary Fellow. In March of this year, he received the President's Award for Distinguished Federal Civilian Service.

Also during 1981, he received the Smithsonian Institution's prestigious Langley Award, given only 16 times since 1908. Recipients include the Wright Brothers, Charles Lindbergh, and James Webb, first NASA Administrator.

A native of Macon, Mo., Jones now lives in Los Altos Hills, CA.

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## Note to Editors:

An opportunity to interview one of the major innovators of aeronautical science and see his latest unusual design on the ground and in flight will occur at NASA's Ames Research Center on Thursday, Dec. 10 at 10 a.m.

R. T. Jones is discoverer of the swept wing, long standard for jet aircraft; and his latest design is the Oblique Wing aircraft. A research version of this radical innovation, the NASA AD-1, normally based at Ames' Dryden Flight Research Facility, will be flying at Ames on Thursday for pilot familiarization and other work.

Jones' Oblique Wing aircraft may be the optimum high-speed jet of the future because it is unique in being able to fly with maximum fuel efficiency at both low and high speeds (up to mach 1.4-low speed supersonic).

The design involves a wing which pivots on the fuselage, so that wing and fuselage are like a pair of scissors. For take off and low speed flight, the wing is straight across the fuselage (highly fuel efficient). For high speed flight, the single rigid wing is swung to a hard-to-believe highly oblique angle, with one wing tip toward the nose, the other, the tail. This oblique configuration is also highly fuel efficient.

Because of its straight-wing efficiency at low speeds, the design also has important advantages in noise abatement, landing vortices, and operating flexibility.

At 10 a.m. there will be a briefing on the aircraft with Jones and the AD-1 pilot. Afterwards, news reporters can view and photograph the plane on the ground. It will then take off and fly by, with the wing skewed to a high angle, performing some test maneuvers.

Reporters planning to attend should come to the NASA gate of Moffett Field, and will be directed from there.



Peter Waller  
Public Information Officer

Dec. 7, 1981

# NASA News

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Dec 10

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IMMEDIATE

## 'FLYING WIND TUNNEL' INAUGERATED AS NEW NASA RESEARCH TOOL

A "flying wind tunnel," designed specifically to study advanced helicopter rotor systems under actual flight conditions, was recently inaugerated at NASA's Ames Research Center.

The Rotor Systems Research Aircraft (RSRA), on its first NASA-piloted flight test, flew over San Francisco Bay at speeds up to 120 knots (138 mph) for 45 minutes.

The RSRA will provide research information similar to that obtained from wind tunnel testing of rotors, but its data is unique because it is obtained in flight.

On its maiden research flight, the helicopter-type aircraft was also equipped with fixed wings and jet engines which will provide a portion of the needed lift for the study of helicopter rotors too small to support the research aircraft alone.

For the initial test phase, the rotor system is the same type as that used on Presidential helicopters -- providing a reliable rotor for these first flights.

(more)

December 10, 1981

## New Research Tool

Warren Hall piloted this first flight for NASA. The co-pilot was Lt. Col. Bob Merrill, deputy director of the U.S. Army flight test activity at Edwards Air Force Base, Calif.

A second RSRA aircraft has been flown at Ames in the basic helicopter configuration. The two RSRA aircraft, funded by NASA and the U.S. Army, are located at Ames to provide a national facility for in-flight investigation and verification of new helicopter rotor system concepts and technology. They can be flown as a helicopter or can be equipped with the fixed wings and auxiliary jet engines to enhance the vehicle's test capability.

Research programs will be aimed at increasing rotor aircraft speed, performance, reliability and safety, as well as reducing helicopter noise, vibration and maintenance.

In the helicopter configuration, the RSRA utilizes a Sikorsky S-61 rotor and a drive system consisting of two T-58-GE-5 turboshaft engines, the main transmission, the 19-meter (62-foot) diameter main rotor, tail takeoff drive shaft, intermediate gear box, tail gear box and the 3.35-meter (11-foot) diameter tail rotor. The horizontal stabilizer is a "T"-tail with a 4.04-meter (13.25-foot) span.

In the compound configuration, a wing and two auxiliary jet engines are added and the tail is modified with the addition of a 6.86-meter (22.5-foot) span stabilator (stabilizer-elevator) and a rudder and associated controls. The wing has a 13.7-meter (45-foot) span and includes both aileron and flap surfaces. The two auxiliary jet engines are TF-34-GE-400A high-bypass-ratio turbofans with maximum rated static thrust of 4,207 kilograms (9,275 pounds) each.

(more)

December 10, 1981

## New Research Tool

The two RSRA aircraft were originally built by Sikorsky Aircraft Division of United Technologies Corporation for NASA's Langley Research Center, Hampton, Va., and the U.S. Army Research and Technology Laboratories (AVRADCOM) with headquarters at Moffett Field, Calif. The two aircraft were transferred to Ames Research Center in 1979 for the joint flight research program by Ames and the Army.

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December 10, 1981

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## BOEING-VERTOL AWARDED ADVANCED TECHNOLOGY ROTOR BLADE CONTRACT

NASA's Ames Research Center, Mountain View, Calif., has selected Boeing-Vertol Co., a division of the Boeing Co., Ridley Park, Pa., for final negotiations of a contract for the development of advanced technology rotor blades.

Boeing-Vertol's estimated value of the six-year contract is approximately \$13 million.

The new rotor blades, which will be flown on the NASA/Army Tilt Rotor Research Aircraft, will provide increased performance and margins of safety and will demonstrate the use of advanced composite materials in this type of aircraft.

The Tilt Rotor Research Aircraft has engines with helicopter-like rotor blades. The engines tilt up for vertical take-off and landing and tilt forward for horizontal flight.

The contractor will supply all personnel, materials and facilities to design, manufacture and structurally test the blades. In addition, the contractor will conduct a test of the blades in the Ames 40 by 80-foot wind tunnel and optionally conduct, in conjunction with government personnel, 30 hours of flight testing.

The unsuccessful bidder was Bell Helicopter-Textron, Arlington, Texas.

-end-

December 17, 1981

# NASA News

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## Ames Research Center

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January 20, 1982

### VENUS CONFERENCE REPORTS NEW DISCOVERIES

Note: The recent international Venus Science Conference at Palo Alto, CA has produced important new findings about the cloud-draped planet. Much of this information comes from the several spacecraft and 30 experiments of the Pioneer Venus missions (including the Orbiter, still returning daily information). The new findings are available only now because of: complexity of the Pioneer missions and large amount of data returned, Pioneer as a low cost program, and the value of comparisons with Russian Venus data. A Fact Sheet on these results will be released shortly, but the listing here outlines a majority of the important recent findings.

Dramatic new finds about Venus, the Earth's twin planet, were reported at the NASA-University of Arizona sponsored first International Conference on the Venus environment, held in Palo Alto, CA, Nov. 2-6, 1981.

These include: evidence for two major, currently active volcanic areas on the planet; the probability that these areas are the principal vents for the planet's internal heat; quantified findings that Venus has a thicker crust than Earth and is a "one plate" planet with little plate tectonics; and complete, self-consistent models of Venus' cloud system and

greenhouse effect. Considerable progress has also been made in understanding over all atmosphere circulation (with implications for Earth); and there is strong new evidence for former Venusian oceans on the scale of the Earth's oceans.

Several hundred scientists from the U. S. and other countries attended the recent Venus conference. Much of the new information comes from data returned by the six Pioneer spacecraft and their 30 experiments. The Pioneers are managed by NASA's Ames Research Center, Mountain View, CA.

Much of the significance of Venus findings in general lies in the fact that the Earth and Venus appear to be almost identical copies of each other. Scientists believe the Earth would become a virtual Venus if you stopped its rotation, removed the Moon, and moved our planet slightly closer to the Sun. Therefore, studies of Venus provide a variety of insights into Earth mechanisms.

New Venus discoveries included:

1) Apparently there are two major volcanic regions on Venus: Beta Regio and the Scorpion Tail of Aphrodite Terra, largest continent-like upland region on the planet. There is evidence for continuous and current volcanic activity at both places.

2) Detailed analysis of Venus' global topography, and detailed comparisons with global crustal-density (derived from gravity data), show that Venus apparently has a thicker crust than Earth and is a "one plate planet." Substantial evidence indicates that its crust is not broken into many continent-bearing plates, floating on the liquid interior, as the Earth's

crust is.

3) Because of its thick, planet-wrapping crust, most of Venus' interior heat appears to come out in its two volcanic regions, unlike Earth. Earth vents its heat at many points, especially at the constantly-expanding mid-ocean ridges. Concentration of Venus' lightning over just two volcanic regions suggests fairly frequent current volcanic activity in both places.

4) Though Venus' continents appear not to drift around on crustal plates as Earth's do, crustal density measurements suggest local uplifting of large regions. This is probably due to up-flowing convective plumes, resulting from circulation of interior magma. The most prominent of these are Aphrodite Terra and Ishtar Terra. Vertical motion of the crust also is suggested by the several deep rift valleys, one the lowest point on the planet, at the Scorpion Tail of Aphrodite.

5) Beta Regio, a region larger than the Hawaii-Midway chain, appears to be a huge double-shield volcanic construct, and is apparently the most active region on the planet. This is shown by variations in crustal density, apparent old lava flows, and the region's 20,000 foot height and huge size. Beta is believed to sit over a powerful, upflowing convective plume, deep in Venus' interior magma.

6) The new topography data show other smaller volcanos and one crustal rift 1500 km long.

7) Venus' clouds are "upside down". There's a smog layer on top, 15 km deep, and Earth-like condensation clouds (made of

sulfuric acid droplets) below 57 km, extending down to 48 km. These condensation clouds are patchy and vary in density. They produce drizzle but seldom hard rain, and in general are only ten percent as thick as comparable Earth clouds. Scientists also have now charted and quantified the basic cycle of chemical reactions in the clouds.

8) Unlike Earth, which absorbs most solar heat on its surface, Venus absorbs most solar heat in its clouds. In the cloud layer is a single convective circulation cell which carries heat from equator to pole. Earth has three linked major circulation cells transporting heat between equator and poles.

9) Venus' cloud region is also a shell of high-speed winds which englobes the planet. Above this wind layer, the atmosphere is almost dead calm. There are two explanations for these high-speed winds on a planet with no rotation. Both propose wave (eddy)-pumping of the enormous momentum of the planet's dense lower atmosphere to higher altitudes where the momentum remains. One of these proposed mechanisms involves large horizontal eddies; the other, tidal effects as the lighted hemisphere moves slowly around the planet. Weather theoreticians agree that: wave pumping mechanisms are critical to understanding Earth's weather, are not well understood on any planet, and have been brought into prominence by recent Venus work.

10) Venus appears to have had an ocean and lost it to space. During the solar system's early history (when scientists believe the Sun was 30 percent less hot), Venus' atmosphere and

environment could have been Earth-like. Strong evidence for this lost water remains today in the definitive measurement of the ratio of deuterium to hydrogen (There is 100 times as much deuterium relative to hydrogen on Venus as on Earth. This measurement was found for the first time in the Pioneer data during the recent Venus conference ) With water abundant, the planet may perhaps have sustained life during the early years of the solar system's history. When the runaway greenhouse effect began, it wiped out most existing phenomena on the planet and replaced them with today's furnace-like environment.

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# NASA News

National Aeronautics and  
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**Ames Research Center**  
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Jan 17 X

Mike Sheehan

For Release.

Evvie Rasmussen

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Release No. 82-2

IMMEDIATE

## PLANT EMISSIONS ADD TO BAY AREA AIR POLLUTION

Emissions from plants, trees and other biogenic sources contribute significantly to air pollution in the San Francisco Bay Area, according to results of a study conducted jointly by the Association of Bay Area Governments (ABAG), the Bay Area Air Quality Management District (BAAQMD) and NASA's Ames Research Center.

The study was designed to provide air quality planners with previously unavailable scientific data on how much these natural emissions actually affect the air we breathe.

Information incorporated into the 12-month project included a regional vegetation distribution map derived from NASA's earth resources satellites program, along with data on biogenic emissions rates collected from a survey of U.S. experts.

Overall results indicate that plant-generated hydrocarbons -- organic gases which can combine with nitrogen oxides in the presence of sunlight to form ozone, a primary air pollutant -- may account for as much as 33 percent of total air quality problems in the nine-county region surrounding the San Francisco Bay.

BAAQMD statistics show that man-made hydrocarbons emitted by motor vehicles and organic solvents, such as paints, are the main culprits in ozone formation for the Bay Area. These ozone levels currently exceed federal standards. Prior to the study, however,

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## Plant Emissions

the effect of biogenic hydrocarbon emissions on smog concentrations was unknown. This new data will help ABAG and BAAQMD develop and administer a more realistic air pollution abatement program.

"This biogenic hydrocarbon emissions inventory will lead to a more accurate approach for dealing with air pollution in the Bay Area," explained Dr. Don Hunsaker, ABAG's environmental engineer for the project. "When preparing air quality programs in the past, it was assumed that biogenic sources contributed nothing to ozone levels, or that they contributed an amount that could not be verified. Now, we have generated an estimate of what role these biogenic sources play, which will help us formulate ozone control strategies that are more certain to succeed."

## BAY AREA VEGETATION MAPPED BY SATELLITE

ABAG compiled the biogenic hydrocarbon emissions inventory by using two major data bases. Working with data analyst Gene Fosnight of Technicolor Graphic Services (a NASA-Ames contractor) ABAG's Roberta Moreland produced a distribution map of Bay Area vegetation from imagery recorded by NASA's Landsat satellite in 1976. This map consists of 22 different land cover classes, including hardwood forest, grasslands, urban open space and wetlands.

In conjunction with Moreland's work, ABAG's Hunsaker determined emission rates by requesting that scientists engaged in biogenic emission research in the United States estimate outputs for each Landsat-derived land cover class. Both the land cover data file and emissions rates were then entered into ABAG's Bay Area Spatial Information System (BASIS), a compilation of geographic data covering the region. As a result, a series of natural hydrocarbon emissions files was created.

"Landsat provided a way for us to find out how vegetation was distributed across the Bay Area, and how much of each vegetation class existed," stated Paul Wilson, a consultant to

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## Plant Emissions

ABAG. "By integrating Landsat data into the computer-based BASIS and assigning emissions rates to the various vegetation classes, it was possible to compile a regional inventory of all natural hydrocarbon emissions."

Moreover, biogenic emissions data have been integrated into the Livermore Regional Air Quality Model (LIRAQ), a photochemical dispersion model developed by Lawrence Livermore Laboratory. In formulating the 1982 Bay Area Air Quality Plan, ABAG and BAAQMD will utilize the LIRAQ model in determining the degree of hydrocarbon emissions control required to attain federal ozone standards in the region before 1987.

## TIGHTER REGULATIONS POSSIBLE

Although ABAG air quality program manager Ron Wada noted that the inventory's uncertainty runs about plus or minus 50 percent, he pointed out the importance of including biogenic information -- as well as its possible consequences -- in Bay Area air quality programs.

"By ignoring the biogenic emissions component, we are misleading ourselves as to how effective any ozone control program is going to be," he said. "We have no control over natural hydrocarbon emissions, but we can regulate emissions put into the air by cars and industry. As a consequence, meeting clean air standards established by the federal government may require stricter controls on man-made sources to compensate for natural emissions."

Because of this possibility, Wada explained, inclusion of natural hydrocarbon emissions in air pollution control plans is a politically sensitive issue.

"Biogenic emissions have become a source of controversy among government regulatory agencies and industry," Wada declared. "The problem is that both sides are arguing qualitatively. Industrial people claim that most ozone, up to the level of established standards, is caused by background

(more).

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## Plant Emissions

sources, such as biogenic emissions, so there is no point to controlling industry. On the other hand, I think regulatory agencies tend to overreact to this line of argument by contending that biogenic emissions are insignificant. Both of these positions are wrong. Neither side has looked at the situation quantitatively."

But, as ABAG's Hunsaker sees it, the situation may be improving.

"During past months, a number of air quality meetings have been held and these problems have been discussed quite a bit," he noted. "As a result, I believe people are starting to agree on this issue."

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January 14, 1982

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IMMEDIATE

## SHUTTLE GREENHOUSE DELIVERED FOR STS-3 PAYLOAD INTEGRATION

A miniature greenhouse has been delivered for integration with the payload of the third Space Shuttle test flight, scheduled for the week of March 22.

Called the Plant Growth Unit (PGU), the compact greenhouse is managed by Dr. John Tremor and Ronald Mancini, both of NASA's Ames Research Center, in conjunction with the principal investigator, Dr. Joe R. Cowles of the University of Houston.

Tremor delivered the primary unit to NASA's Kennedy Space Center, Florida, where shuttle payload integration is taking place. A back-up unit was delivered to Cowles for his experimental use.

The first flight of the orbiting greenhouse will test the effect of weightlessness on the formation of lignin in plants. Lignin is the woody substance in plants which allows them to grow upward against the pull of gravity, gives them their characteristic shapes and supports the organs which carry food and chemicals. It makes up as much as 30 percent of plant tissue.

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Controlling lignin is economically attractive, because lignin interferes with extraction of wood fibers for the production of paper and plastics. In many plants it also competes with food production.

Gravity appears to be a fundamental stimulus for the production of lignin. By comparing Earth-grown and space-grown plants, scientists hope to better understand the development of lignin and to some day learn to regulate it.

Scientists believe that lignin production will decrease in space, but that plants still will grow upward in response to the growth unit's artificial sunlight. They are not sure how roots, less responsive to light, will grow.

U.S. scientists have not had the opportunity to test their theories in the weightless environment of space. Russian scientists have reported that shoots and roots grown under weightless and dark conditions have grown along the lines determined by the seeds' original placement in the medium.

A total of 96 plants will be carried aboard the orbiter Columbia in six 25-centimeter (10-inch) plant growth chambers. Oat and mung bean seeds and young slash pine seedlings will be planted just before launch in the rectangular, terrarium-like chambers. All are compact species able to grow in the limited space available and under relatively low light conditions.

Sixteen seedlings will be planted in each chamber, in sandwiches of moist sponge and filter paper. The chambers will be sealed and placed in the Plant Growth Unit, which will be loaded late in the launch countdown into a single locker space on the forward bulkhead of the orbiter's mid-deck.

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## Shuttle Greenhouse

The Plant Growth Unit, which is the size of a filing cabinet drawer, is completely automatic, requiring no flight crew interaction. All data are stored within the experiment package. The unit provides light and temperature control and includes batteries, a tape recorder and controlling electronics.

During the eight-day mission the plants will receive 14 hours daily of artificial sunlight. Researchers will be able to tell from the data whether growth direction varied under light or dark conditions.

Immediately after the Columbia lands, the unit will be removed and the plants will be photographed and analyzed. Results will be compared with those from identical Earth-grown seedlings.

The lignin experiment is one of the first of several plant experiments planned for Space Shuttle. The results of this first study will help determine the choice of plants to fly under similar conditions aboard the European-built Spacelab on its second shuttle flight, scheduled for late 1984.

The Plant Growth Unit was built for this and future shuttle missions by Lockheed Missiles and Space Company and the Life Sciences Flight Experiments Project Office at Ames. The project office, managed by William Berry, is responsible for all non-human experiments aboard the Space Shuttle. The office is part of the Ames Life Sciences Biosystems Division.

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February 4, 1982

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IMMEDIATE

## PIONEER 10 COMPLETES TEN YEARS IN SPACE, NEARS EDGE OF SOLAR SYSTEM

Pioneer 10, the first spacecraft to Jupiter, now making man's first trip out of the solar system, will complete ten years in space on Tuesday, March 2, 1982.

Since launch in 1972, the far-traveling U.S. spacecraft has traversed the asteroid belt, survived Jupiter's punishing radiation belts, and operated almost without flaw. Pioneer 10 has traveled 3.27 billion miles, received over 40,000 commands from Earth, and transmitted more than 125 billion bits of scientific data.

With one exception, Pioneer continues to function well, and is currently engaged in a new enterprise, defining the extent and behavior of the Sun's atmosphere, the magnetic bubble which contains the Sun and the planets. This "bubble" in the interstellar medium is called the heliosphere.

Pioneer 10 now is more than half way between the orbits of Uranus and Neptune, 2.5 billion miles from the Sun.

About a year from now in April 1983, Pioneer will be farther from the Sun than the planet Pluto. By June 1983, it will be

farther out than Neptune--outside all of the planets of the solar system, in their current positions.

Pluto's orbit is so elongated that the "outermost planet" will be inside Neptune's orbit for the next 17 years. NASA officials have, therefore, selected October 1986 (when Pioneer crosses the mean orbit of Pluto) as the official date for the first spacecraft's leaving the solar system. Pioneer will cross the farthest extension of Pluto's orbit in April 1989.

At Pioneer's current distance of 2.5 billion miles, it takes three hours and 42 minutes for spacecraft data, traveling at the speed of light, to reach the Pioneer Operations Center at NASA's Ames Research Center, Mountain View, CA. This one-way communication time currently is increasing at a rate of one minute every four days.

Despite damage from intense Jovian radiation, and hits by tiny micrometeoroids, plus ten years of continuous operation, almost all systems are performing well. Pioneer's magnetometer ceased to function in 1975, but experimenters can calculate the interplanetary field from charged particle trajectories, magnetic data already gathered, and several correlations from five other Pioneer scientific instruments.

Scientists await current spacecraft findings "with intense excitement," says Dr. James A. Van Allen, University of Iowa, Pioneer 10 experimenter, "because we think the Sun is typical of a majority of the stars in the universe. It's the only star we can measure from 'close up'. Finding the extent and exact mechanisms of the Sun's atmosphere will tell us a great deal

about the Sun itself, about the interstellar gas surrounding the solar system, and hence about stars in general."

The picture now emerging seems to show that the heliosphere is enormous, far larger than predicted. The heliosphere (created by the million-mile-an-hour solar wind, blowing out from the Sun in all directions) appears to be a tear-shaped magnetic bubble. The bubble is "streamlined" by the motion of the solar system through the interstellar gas. (See illustration.)

Pioneer is traveling "down the tail" of the heliosphere tear drop. The spacecraft is seeking the "skin" of this heliospheric bubble, the boundary between the Sun's atmosphere and true interstellar space. No one knows, but scientists think this boundary region may lie between five and 10 billion miles from the Sun.

Experts at NASA's Deep Space Network expect to be able to track Pioneer out to somewhere beyond five billion miles.

At the long-lived spacecraft's current distance, the Earth would be seen as a pin point of light, never more than  $2.2^{\circ}$  away from a Sun still intensely bright, but no larger than a pin head. Because of this huge distance, and the decline in brightness of the Sun, Pioneer's sun sensor will not be able much longer to provide the sun pulse, which gives rotational position of the spinning spacecraft several times a minute. However, NASA-Ames mission controllers have devised, and will soon be using, a method of making star maps with the Pioneer camera (Imaging Photopolarimeter) to provide the needed rotational and attitude data.

Pioneer 10 has an array of achievements and discoveries.

Some are:

1. First trip to Jupiter.
2. First crossing of the Asteroid Belt and finding that it presents little hazard to spacecraft.
3. Discovery that Jupiter is a liquid planet.
4. First model of Jupiter's huge, pulsating, magnetosphere and tremendously powerful radiation belts.
5. First accurate measurements of mass and densities of Jupiter's planet-sized moons, key to the planet's formation history.
6. First closeup pictures of Jupiter's Great Red Spot and belts and zones showing details of atmosphere circulation.
7. Proof of origin of the gegenschein and zodiacal light.

\* \* \* \*

Recent Pioneer discoveries about the space at the edge of the solar system raise other new questions.

We now believe the heliosphere bubble "breathes" in and out once every 11-year solar cycle, says Dr. John Simpson, University of Chicago, Pioneer experimenter.

The shock waves of the enormous storms on the Sun seem to persist in the heliosphere for as long as a year, probably changing the heliosphere bubble's shape, as if it were a huge pulsating jelly fish.

"It's hard to overstate the interest of the physics coming out of this phase of the Pioneer mission," comments Dr. Aaron Barnes, NASA-Ames astrophysicist. "We are constantly entering

unexplored territory, and we really don't know what we'll learn about our local star."

Other recent findings about the heliosphere:

1) The solar wind was expected to slow with distance from the Sun, but this has not happened. Almost no motion energy has been lost as heat.

2) The primary source of turbulence in the outer heliosphere is storms on the Sun, not solar wind collisions.

3) Near solar maximum, cosmic ray particles incoming from the galaxy in all velocity ranges (even near light speed) become half as numerous or are shut out completely from the heliosphere.

4) For unexplained reasons, high velocity streams of electrons from Jupiter moving through the heliosphere don't wobble as expected from the planet's axial tilt.

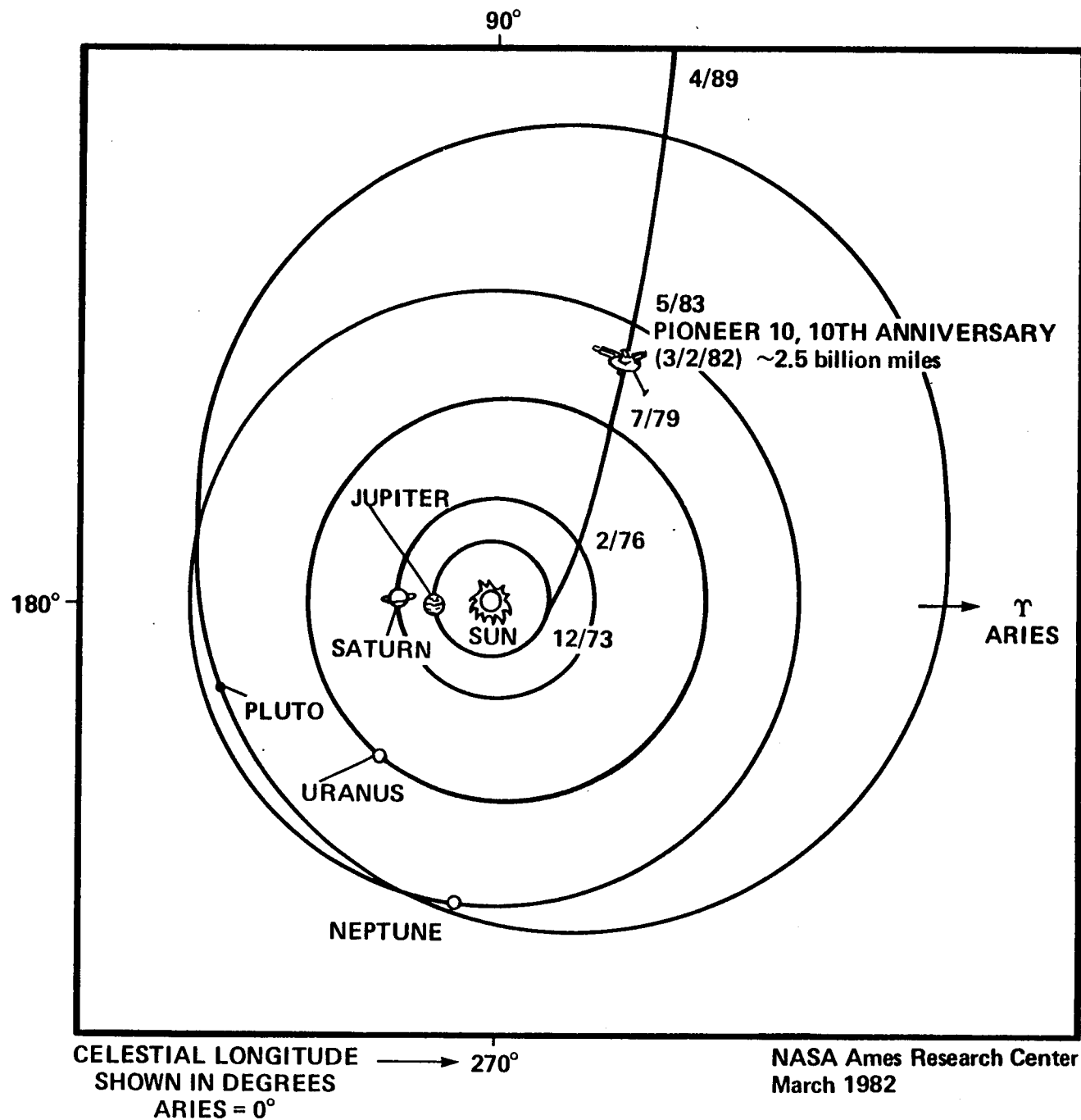
5) The heliosphere is bisected by a 'flapping' current sheet, aligned with the Sun's equator, and believed to extend to the interstellar boundary.

6) As solar storm activity builds up, the heliosphere is believed to deform into a more oval shape lined up with the Sun's equator, from its rounder shape at solar minimum. It also may expand in size.

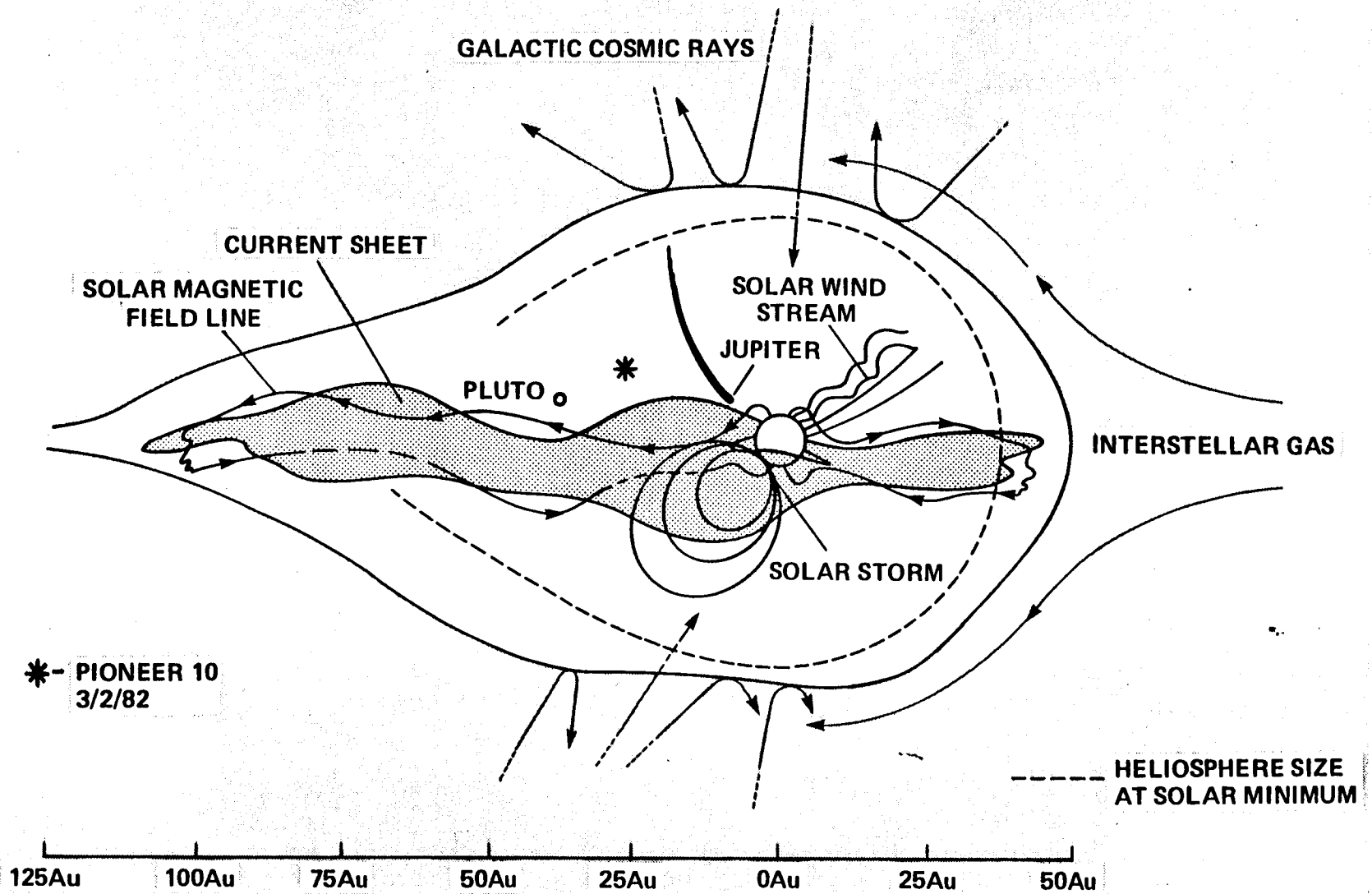
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NOTE: ATTACHED ART IS INTENDED FOR NEWSPAPER  
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# MAP: PIONEER 10 LEAVES SOLAR SYSTEM



# HELIOSPHERE AT SOLAR MAXIMUM



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IMMEDIATE

## AMES DEVELOPMENTS CHANGING SHUTTLE TILE SYSTEM

New developments at NASA's Ames Research Center are changing the face of the Space Shuttle's thermal protection system.

Second generation materials -- lighter, stronger and more cost-effective than original components -- have been developed by Ames and will be installed in stages on four shuttle orbiters over the next several years.

Some new materials already have been installed on the orbiter Columbia. Others are planned for Challenger, currently being built for delivery this summer, and for Discovery and Atlantis, scheduled for delivery in 1983 and 1984.

The shuttle thermal protection system consists of tiles and other refractory materials applied to the outer shell of the orbiter to protect its aluminum and graphite-epoxy skin from extreme temperatures. Temperatures on a space shuttle flight may range from  $-110^{\circ}\text{C}$  ( $-170^{\circ}\text{F}$ ) in space to nearly  $1648^{\circ}\text{C}$  ( $3000^{\circ}\text{F}$ ) at some points during reentry.

Changes in the system reflect NASA's growing understanding of the problems of reentry. Although original materials

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March 4, 1982

## Ames Developments

performed well beyond expectations, NASA research continues to produce more sophisticated materials, according to Howard Goldstein, head of the Ames Thermal Protection Materials Section.

Shuttle orbiter Columbia has had a silica glass quilt, called Advanced Flexible Reusable Surface Insulation (AFRSI), installed over 20 sq. ft. of its elevon cove, replacing the Felt Reusable Surface Insulation (FRSI) which originally covered the area.

FRSI had to be replaced because temperatures in the elevon cove area reached  $816^{\circ}\text{C}$  ( $1500^{\circ}\text{F}$ ). FRSI was designed for areas no hotter than  $398^{\circ}\text{C}$  ( $750^{\circ}\text{F}$ ). Plans had been to install AFRSI in some areas on the next orbiter, Challenger, but the overheating brought a decision to add the new materials for the second flight of Columbia.

AFRSI is tougher, lighter and cheaper than earlier tile heat shields. It was conceived by Ames and produced by Manville Building Materials Corp., Denver, Colo. A square foot of AFRSI costs about \$200, compared to about \$1000 a square foot for tile materials.

On Challenger, AFRSI will be installed on the Orbital Maneuvering System (OMS) pods and will partially replace Low Temperature Reusable Surface Insulation (LRSI) tiles developed and manufactured by Lockheed Missiles and Space Co., Sunnyvale, Calif.

On orbiters Discovery and Atlantis, AFRSI will replace all the LRSI and parts of the FRSI, covering more than 2,700 square feet. Also on these future orbiters, another new material called

(more)

March 4, 1982

## Ames Developments

Fibrous Refractory Composite Insulation (FRCI-12, 12 pounds per cubic foot) will replace LI-2200 tiles. Both of these materials were developed by Ames and are manufactured by Lockheed.

The new FRCI-12 is lighter and stronger than LI-2200 and will save about 1000 pounds on Discovery and Atlantis.

Four principal types of materials comprised the original thermal protection system: Felt Reusable Surface Insulation, effective for temperatures less than 398°C (750°F); LRSI tiles, covered with a white borosilicate glass coating effective from 371°C (700°F) to 648°C (1200°F); High Temperature Reusable Surface Insulation (HRSI), covered with a black reaction-cured glass coating which is used for 648°C (1200°F) to in excess of 1260°C (2300°F); and Reinforced Carbon-Carbon, effective for temperatures up to 1648°C (3000°F).

LRSI and HRSI tiles come in two densities: the LI-2200, 22 pounds per cubic foot, and LI-900, nine pounds per cubic foot. The latter material was developed and is manufactured by Lockheed.

HRSI is covered with the black, reaction-cured borosilicate glass coating developed by Ames to protect the high temperature areas, about 43 percent of the total surface of the orbiter. The white, borosilicate-coated LRSI tiles are located primarily on the upper surface of the orbiter.

Another Ames development used in the thermal protection system is the Ames gap filler, which fills nearly 5,000 gaps between tiles, where it prevents hot gas from reaching the shuttle's aluminum skin.

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March 4, 1982

## Ames Developments

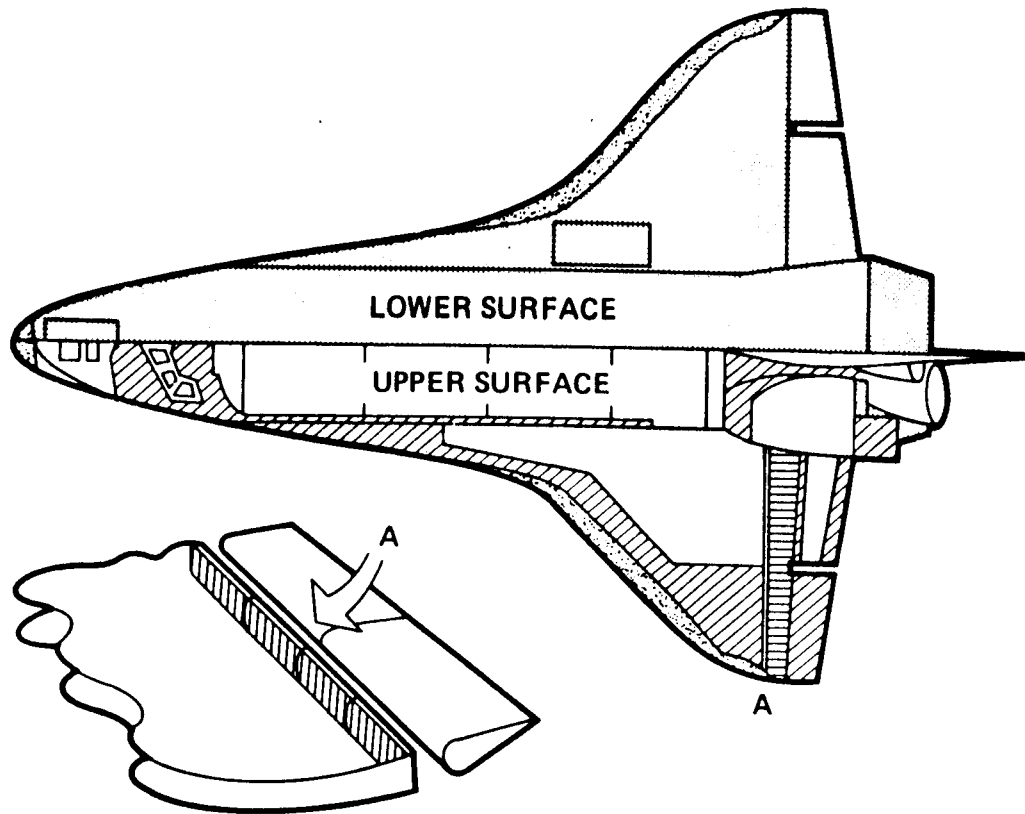
AFRSI, FRCI, the Reaction Cured Glass Coating, Ames gap fillers and LI-2200 were developed by the Thermal Protection Materials Section, headed by Howard Goldstein. Among those on the team that developed these materials were Goldstein, Dan Leiser, David Stewart, Marnell Smith, Paul Sawko, and Carlos Estrella, all of the Thermal Protection Materials Section, and Vic Katvalla and James Dewitt of the Ames Technical Services Division. All of the materials except Advanced Flexible Reusable Surface Insulation have been patented.

The Thermal Protection Materials Section is part of the Ames Entry Technology Branch. Branch chief is Howard Larson.

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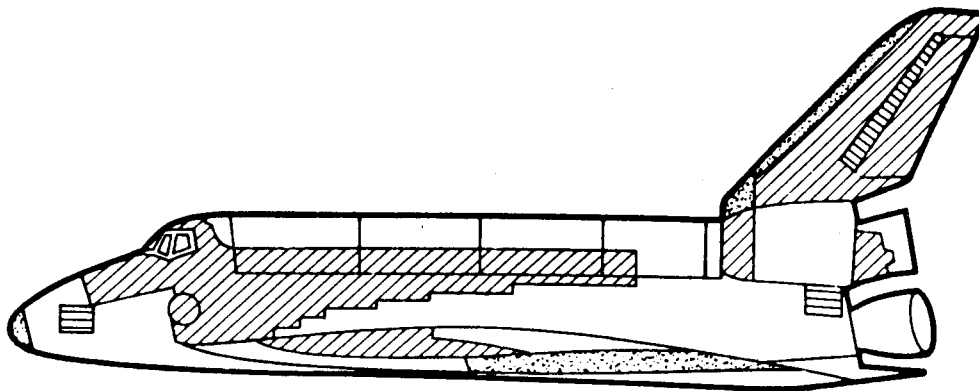
March 4, 1982

# **THERMAL PROTECTION SYSTEM** **SPACE SHUTTLE COLUMBIA, ORBITER 102**



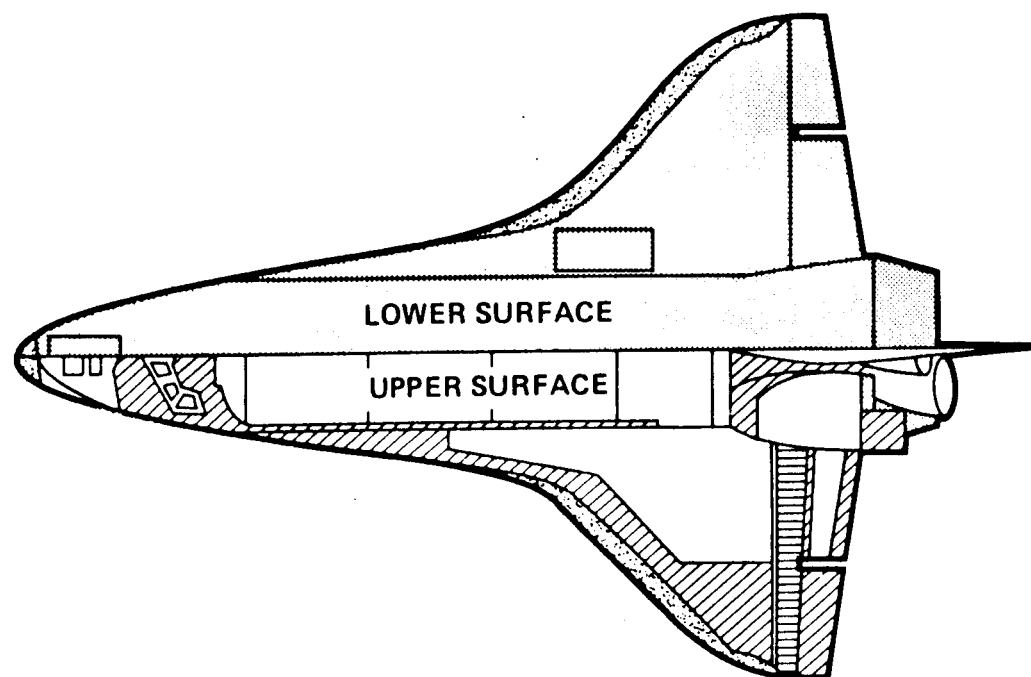
- REINFORCED CARBON-CARBON (RCC)**
- HIGH TEMPERATURE, REUSABLE SURFACE INSULATION (HRSI)**
- LOW TEMPERATURE, REUSABLE SURFACE INSULATION (LRSI)**
- COATED NOMEX FELT, REUSABLE SURFACE INSULATION (FRSI)**
- METAL OR GLASS**






**A ELEVON COVE INSULATION –  
 ADVANCED FLEXIBLE, REUSABLE  
 SURFACE INSULATION (AFRSI)**



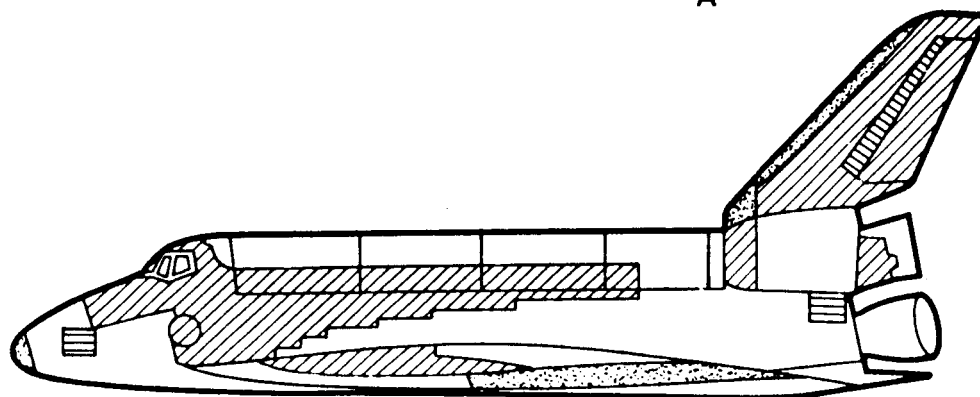
# THERMAL PROTECTION SYSTEM

## SPACE SHUTTLE CHALLENGER, ORBITER 099



-  REINFORCED CARBON-CARBON (RCC)
-  HIGH TEMPERATURE, REUSABLE SURFACE INSULATION (HRSI)
-  LOW TEMPERATURE, REUSABLE SURFACE INSULATION (LRSI)
-  COATED NOMEX FELT, REUSABLE SURFACE INSULATION (FRSI)
-  METAL OR GLASS

A ADVANCED FLEXIBLE REUSABLE, SURFACE INSULATION (AFRSI)  
WILL BE USED IN ELEVON COVE AREA OF THE WINGS THE AFRSI BLANKET WILL ALSO REPLACE SOME LRSI TILES IN THE OMS PODS AREAS



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Release No. 82-06

For Release

IMMEDIATE

NOTE: This story is being jointly released by NASA Ames and the University of California, Santa Cruz.

### UC SANTA CRUZ' LICK OBSERVATORY AND NASA AMES SIGN COOPERATIVE RESEARCH PACT

An agreement to collaborate on observational and theoretical research in astronomy has been signed by the directors of Lick Observatory at the University of California, Santa Cruz and NASA Ames Research Center, Mountain View, CA.

Lick operates a major ground-based astronomical facility on Mt. Hamilton while NASA Ames operates the Kuiper Airborne Observatory and is developing infrared instrumentation and other techniques for future airborne and spaceborne astronomical work.

"NASA Ames personnel involved in these activities require ground-based observing facilities for testing new instruments and concepts and for observations in support of their research," says C. A. Syvertson, Director of NASA Ames Research Center.

Already, the two agencies have done collaborative work in theoretical astrophysics, instrument development, and both ground-based and airborne infrared astronomy, says Lick Director Robert Kraft, who will chair the new cooperative work group.

The UC-Ames Technical/Astronomical Working Group, as it will

- more -

be called, will be headquartered at UC Santa Cruz and will have an associate director chosen from the NASA Ames Research Center staff. The associate director will hold a research associate appointment on the UCSC faculty.

Major goals of the working group will be to develop and test new ground-based optical and infrared facilities, and instrumentation and technology, including equipment to be used in the Space Shuttle program.

Collaborative research will be encouraged by establishing visiting research appointments at UC Santa Cruz for Ames scientists, while UC graduate students in astronomy and astrophysics will be assigned to scientific projects at Ames facilities. Whenever practical, the two agencies will exchange shop and computer facilities.

Large Deployable Reflector scientists and Shuttle Infrared Telescope Facility experts from Ames will be able to learn about large telescope design and technology by working on development problems with Lick scientists and engineers. Lick Observatory operates the Shane 120-inch Telescope atop Mt. Hamilton and is involved in a university-wide project to develop the world's largest telescope, a 400-inch instrument.

Other aspects of the cooperative agreement between Lick and NASA Ames include opportunities for post-doctoral fellows to work with the group and the establishment of visiting research appointments at Lick for distinguished scientist from the United States and abroad. The group will also sponsor symposiums, seminars and publications on astronomical topics.

- end -

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IMMEDIATE

## "MYSTERY CLOUD" EXPLAINED BY NASA U-2

The so-called "mystery cloud" which currently covers most of the Earth's northern hemisphere was almost certainly injected into the stratosphere by a violent volcanic eruption.

A U-2 high-altitude research aircraft from NASA's Ames Research Center, Mountain View, CA has collected samples of the cloud at 50,000 and 55,000 feet (about ten miles up) in the stratosphere, and chemical analysis shows it to consist entirely of sulfuric acid droplets.

If the stratospheric cloud were from a nuclear explosion or meteorite explosion (the other possible sources), it would contain fragments of rocky material. So would a "young" volcanic cloud. An older volcanic cloud in the stratosphere would consist only of sulfuric acid droplets as does the present one. Any rock

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or ash from any one of these sources would have settled out in the first two weeks. The "aging cloud", now spread through the stratosphere, is from six weeks to two and a half months old. It was first detected on January 11, over Hawaii, and has since been measured from many points in the northern hemisphere. The cloud's sulfuric acid composition is virtually certain proof of its volcanic origin.

No volcanic source for the cloud has been identified although the violent eruption of Mount Nyamuragiri in Zaire last December is a possibility. A currently "smoking" volcano on the island of Pagan at about 20 degrees north latitude in the western Pacific is also a possibility.

The stratospheric cloud has been measured from the equator to Germany (about 50 degrees north latitude), with the heaviest concentration of particles found by a NASA Langley Research Center aircraft at 20 degrees north latitude (around the latitude of the Hawaiian Islands).

Zaire's Mount Nyamuragiri is at one degree south latitude. However, in winter, the northern hemisphere weather zone extends south of the equator, probably including the Zairian mountain, and Ames scientists are studying global atmosphere circulation patterns to see how gas from an equatorial source could spread over the northern half of the Earth.

Typically, such volcanic eruptions inject large amounts of sulfurous gases (especially sulfur dioxide) into the stratosphere. Once up there, these gases tend to remain for many months because there is no rain in the stratosphere to remove

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them. In succeeding months, these volcanic gases turn into sulfuric acid droplets. As time passes, the resulting planet-wrapping volcanic clouds can actually increase in depth and density, as more and more sulfuric acid droplets are created.

Because clouds of sulfuric acid droplets are so highly reflective (in Venus' stratosphere, they account for the intense over-all brightness of the planet), even thin clouds of this material can reflect some incoming sunlight back to space, preventing some of the Sun's heat from reaching the ground. The current cloud appears to have come from a moderate eruption, and should produce no climate change. Occasionally, such stratospheric clouds produce some temporary climatic cooling. The last such event was in 1963, and the one before that in 1912. In a few cases, this cooling has been drastic (as in the year 1815 when the huge eruption of Tambora caused the "year of no summer" of 1816).

U-2 stratosphere sampling flights in the next few weeks will try to determine the amount of sulfur gases currently in the stratosphere, rather than numbers of sulfuric acid particles, now being measured by U-2's. This will tell the thickness of the cloud of sulfuric acid droplets these stratosphere gases can be expected to produce during the next few months. At that time, after analysis of these samples, Ames researchers expect to reach some conclusions on possible climatic effects. The present cloud is not expected to produce even minor climatic changes.

Dr. Brian Toon, Ames atmosphere research scientist, estimates that there may be a million tons of droplets and

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several more million tons of sulfurous gases now in the stratosphere.

A volcanic source for the cloud could also come from among the hundreds of active volcanos rimming the Pacific. An undetected eruption might have occurred during heavy cloud cover or at a truly remote volcano. However, an event of this size should still be easily identified, for example, by close airborne inspection of such a "still smoking" volcanic mountain.

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# NASA News

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Barbara Busch 415/965-6364

For Release IMMEDIATE

Release No. 82-12

## NEW CONTRACT CONTINUES SUPPORT FOR PIONEER EXPLORATION PROGRAMS

A nearly two-million dollar contract for continuing support of NASA's several interplanetary Pioneer spacecraft was awarded today by NASA-Ames Research Center to the Bendix Field Engineering Corporation's Advanced Data Systems in Sunnyvale. The contract is in support of the NASA solar system exploration program.

The contract is a cost-plus-award-fee for a two-year period of performance commencing April 1, 1982. Option clauses provide for an additional three years, or a total potential life of five years.

The initial funding authorized is \$500,000, with the estimated cost of the two-year period totaling \$1,852,958.00.

The contract will provide for operation of the seven Pioneer spacecraft: the Pioneer 6-9, Pioneer-Venus Orbiter, and Pioneers 10 and 11.

Pioneers 10 and 11 surveyed Jupiter and Saturn, and both are on their way out of the solar system. Pioneer 10 is mankind's first spacecraft to leave the solar system. Pioneer 10 currently is 2.5 billion miles away from the Sun, and when it crosses Neptune's

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orbit in July of 1983 will be outside the orbit of the farthest planet (since the "outermost planet", Pluto, will be inside Neptune's orbit for the next 17 years, because of Pluto's non-circular orbit). The Pioneer-Venus Orbiter, one of two U. S. spacecraft operating at a planet, is making photos of Venus and measurements of its atmosphere, space environment, and interior composition. Pioneers 6 through 9 have been circling the Sun as solar weather stations and returning information for researchers.

The terms of the contract provide for Mission Flight Operations and Data Processing Support Services, which include flight operational control of the seven Pioneer spacecraft, and operation, maintenance, and upgrading of the Pioneer Mission flight operation and data processing facilities at NASA's Ames Research Center at Mountain View, California.

The work will be performed on-site at Ames. Now doing the work, Bendix was the only respondent to the competitive request-for-proposal. Patrick Baulay is the Bendix Manager, and Richard O. Fimmel is the Pioneer Missions Manager. The parent company of the local Bendix office is Bendix Field Engineering Corporation of Columbia, Maryland. Headquarters for the National Aeronautics and Space Administration is Washington, D. C.

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# NASA News

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For Release: IMMEDIATE

Release No. 82-13

## HELICOPTER FLIGHT SIMULATOR CONTRACT BEING NEGOTIATED

NASA has selected American Airlines' Flight Academy for contract negotiations for installation of a new helicopter simulator system at Ames Research Center, Mountain View, CA. The system will be funded by the U. S. Army and will be used jointly by the Army and NASA.

The system is designed to duplicate helicopter cockpit configurations and flight handling characteristics. The complex will provide a systems approach to rotorcraft design and a simulation capability to support handling quality experiments, flight tests, product improvement evaluations and basic rotorcraft technology.

The new Advanced Cab and Visual System, known as ACAVS, was announced today by officials for both NASA and the Department of the Army. American Airlines' Flight Academy is in Fort Worth, Texas. The proposal was for approximately \$16,000,000.00

Eventually the simulator will be installed in the currently existing Vertical Motion Simulator Facility at NASA-Ames, and will adapt that facility for helicopter simulation.

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Pilots and engineers will use the new system to simulate the total handling characteristics of helicopter flight, including sight, motion and sound. The system can be run as a stationary installation or can use the Vertical Motion Simulator Facility to generate large motions. These up-and-down motions can create an even more accurate feel, for the pilot, of the movements of a helicopter in low-level flight, or "nap of the Earth" flight.

The contract will provide for the fabrication of the Advanced Cab and Visual Systems plus a new development area where the cab can be reconfigured for the next simulation, and installation of the ACAVS into the development area.

Management for the Army will be through the Army's Aeromechanics Laboratory, Research and Technology Laboratories, Aviation Research and Development Command (AVRADCOM). The Aeromechanics Laboratory and the Headquarters for the Research and Technology Laboratories are both located at the Ames Research Center.

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Release No. 82-14

IMMEDIATE

## AIRBORNE OBSERVATORY CAPTURES IMAGE OF SHUTTLE RE-ENTRY HEATING

An airborne infrared telescope has caught an image of the Space Shuttle orbiter Columbia's heating patterns as the orbiter re-entered the Earth's atmosphere March 30, 1982, after its third flight in space.

The Gerard P. Kuiper Airborne Observatory, operated by NASA's Ames Research Center, recorded the orbiter with a 91.5-cm. (36-in.) telescope as Columbia raced overhead at a height of about 185,300 feet, moving at a speed of about Mach 15.6. The project is known as the Infrared Imagery of Shuttle (IRIS) experiment.

"We got a beautiful image," said Dr. William Ballhaus, director of Astronautics for Ames. The Kuiper telescope captured about one-half of the orbiter, Ballhaus said, revealing "hot spots" on the wings and temperature gradations.

"It was a somewhat risky mission," Ballhaus said, because the Kuiper crew took off without knowing whether the orbiter would land at White Sands, New Mexico, or Kennedy Space Center in Florida.

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## Shuttle Heating

The Kuiper had been in place for a Monday entry of shuttle and had to abort its mission when the landing was postponed. The aircraft flew out of Ames again at 5:45 a.m. Pacific Standard Time Tuesday. The crew knew that if the shuttle mission ended at the end of orbit 129 at White Sands, they would have a good chance of getting an image. But if the shuttle had landed from orbit 130 at Kennedy, the sun angle would have prevented the Kuiper telescope from catching it.

A last-minute tracking update, which came 15 minutes before Kuiper's encounter with Columbia, made possible the success of the experiment. The update advised the Kuiper crew that the shuttle was five miles north of the predicted entry point. The Kuiper made a last-minute change in navigation which put the telescope in a position to catch the shuttle.

The IRIS experiment was attempted on the first flight of the Columbia, but the telescope was unable to catch a view of the orbiter using the Kuiper's normal tracking configuration. A major modification of hardware and software was undertaken to prepare the Kuiper for another attempt at imaging the shuttle.

In addition to the major modification to the Kuiper's tracker, simulations of the mission were carried out by the Kuiper crew using U.S. Air Force SR-71 aircraft. The Kuiper tracked two flights of the SR-71 aircraft to test the ability to track the shuttle.

All of these efforts paid off with the third shuttle flight.

"Overall we had a flawless performance for an extremely complex mission," said project manager Henry Lum of Ames, "where

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## Shuttle Heating

changes were happening in real time and adjustments had to be made to accommodate those changes."

A large network of communications helped the Kuiper track the shuttle. Information was provided from mission control at Johnson Space Center, Houston; NASA's Dryden Flight Research Facility, Edwards, Calif.; the Western Test Range, Vandenberg, Calif.; and the 2045th Communications Group, Andrews Air Force Base, Md.

The SR-71 simulations were carried out with the help of the Ninth Strategic Reconnaissance Wing, Beale Air Force Base, Calif.; the U.S. Army Electronics Proving Ground, Fort Huachuca, Ariz.; the 2762nd Logistics Squadron of the Air Force Logistics Command, Palmdale, Calif.; the 2045th Communications Group and the Western Test Range. The Kuiper tracker and its image plane were built by Martin-Marietta Corp., Denver, Colo.

"The success of the mission was a coordinated effort," said Ames' Ballhaus. "People worked long hours, weekends and evenings. Without a number of individual contributions, the mission could not have been successful."

The Kuiper had to capture Columbia as it passed through the telescope field of view. The telescope detector system records on tape an image of the lower surface of Columbia.

After the flight, the infrared data is supplemented by orbiter-derived data on velocity, altitude, angle-of-attack, yaw and roll conditions existing during the period of observation by the IRIS experiment, as well as with temperature data recorded aboard Columbia.

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## Shuttle Heating

The information will help in the development of improved thermal protection materials and techniques. Ames Thermal Protection Materials Section has developed most of the materials used in the shuttle's thermal protection system.

The Kuiper Airborne Observatory is a Lockheed C-141 Starlifter aircraft, equipped with a 91.5-cm. (36-in.) aperture Cassegrain-type reflector telescope which is installed in an open cavity recessed into the port side of the aircraft immediately ahead of the wing. The telescope can be moved in flight over an elevation range of 35 to 75 degrees. It is capable of tracking celestial objects to an accuracy of less than two arc seconds by use of precision gyroscopes and an active digital tracking system.

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IMMEDIATE

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## NASA BEGINS CONSTRUCTION OF AVIATION SAFETY RESEARCH FACILITY

Construction has begun at NASA's Ames Research Center on a unique facility dedicated to the study of human factors in air safety.

Designed for study of the interaction between flight crews, their aircraft and air traffic control, the Man-Vehicle Systems Research Facility will allow work not feasible in existing NASA flight simulators, which were intended primarily for aeronautical rather than human factors research.

Contract for the building was awarded in November to Joel Li of San Lorenzo, Calif. The \$1.3 million building is scheduled for completion in summer 1982.

The entire facility, including two simulators and a mock Air Traffic Control Facility, is scheduled for completion in January 1984 at a cost of \$8.2 million.

One of the simulators is a replica of a Boeing 727 Series 200 aircraft cockpit, complete with flight engineer's station, flight display and control systems. Singer-Link of Binghamton, New York, is building the simulator for delivery in summer

(more)

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## Aviation Facility

1983. Singer-Link also will build the external housing and major mechanical components for the second simulator.

This second simulator will represent technology for aircraft projected to be flying about 1995. With advanced technology flight controls, displays and other flight deck systems for flight crew and observer, the advanced simulator will be designed to test for human safety factors related to the newest aviation technology.

Design, engineering and building of this second simulator is a joint project of NASA's Ames Research Center, Langley Research Center and Lockheed-Georgia Corp. of Marietta, Ga.

The simulation complex will include a visual display capable of depicting dusk or night, aircraft, fog, clouds and other weather conditions, allowing the experimenter to recreate and control visual as well as operational workloads.

A mock Air Traffic Control System will complete the realistic flight simulation. This system is being designed and built by the Flight Transportation Laboratory at the Massachusetts Institute of Technology.

The equipment allows complete simulation of a flight mission. Experimenters can introduce problems such as turbulence, air traffic, fog or mechanical failure. Scientists will be able to study how decisions made in the cockpit are affected by environmental and hardware difficulties, as well as by the availability (both from the ground and from the aircraft) of information about flight status.

(more)

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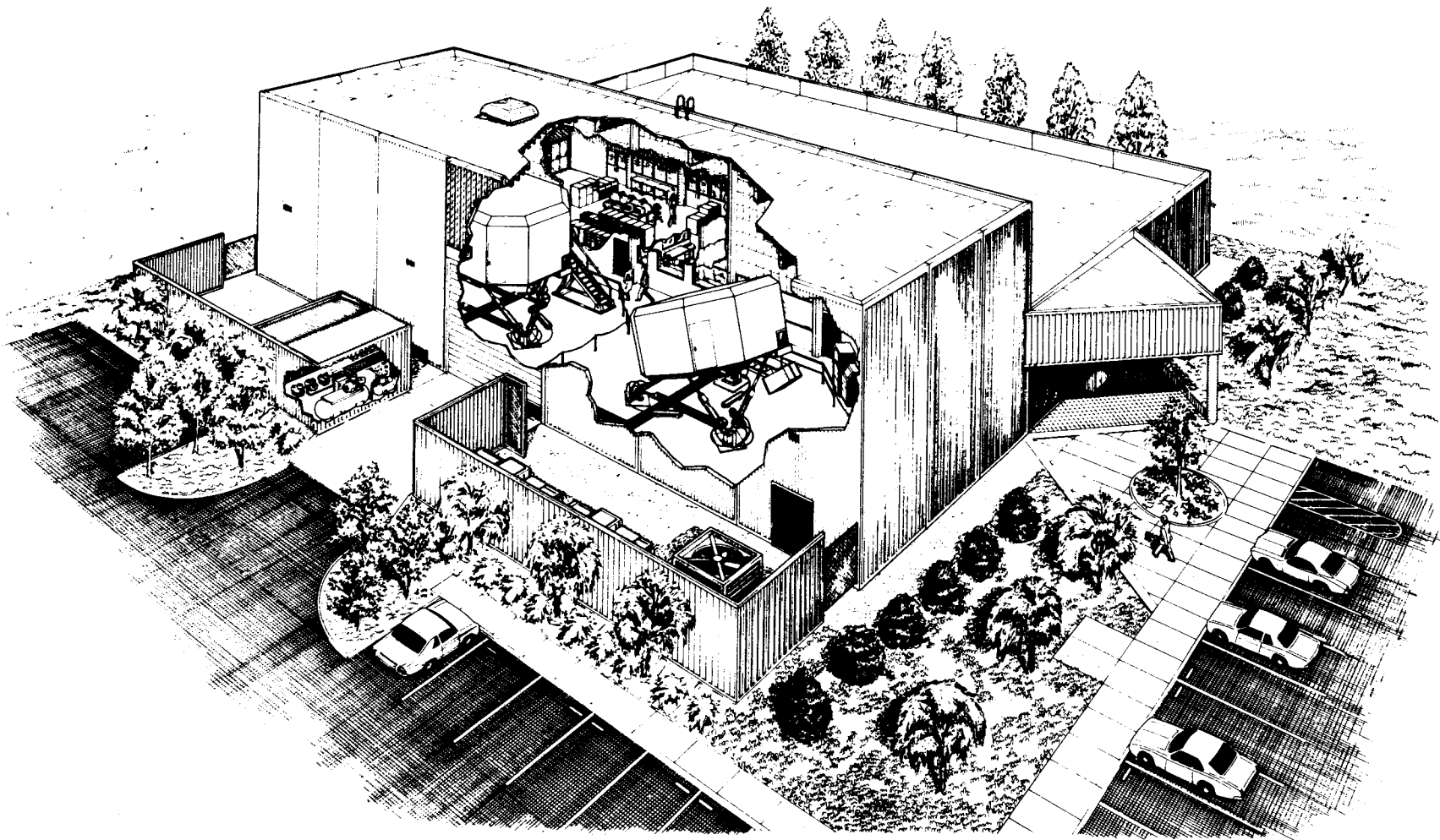
## Aviation Facility

Studies by a number of organizations indicate that human error plays a part in 60 to 80 percent of all aviation accidents. The Man-Vehicle Systems Research Facility will allow scientists to study how errors are made, as well as the effects of automation, fatigue and advanced instrumentation on human performance.

Project manager at Ames is Rodger Hayes. Hayes and Dr. David Nagel, an Ames aviation psychologist, are responsible for the development of the new facility.

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Release No. 82-19

IMMEDIATE

## STUDY FINDS FLIGHT CREW CONVERSATION ESSENTIAL

Quality of cockpit conversation, not quantity, is a key factor in flight crew performance aboard airliners, concludes Dr. H. Clayton Foushee of NASA's Ames Research Center.

Foushee, an aviation psychologist, analyzed the cockpit conversations of airline crews who volunteered to take part in a previous NASA study in 1979. The current research is part of the on-going effort of the aviation community to maintain the outstanding safety record of U.S. civil air transportation. NASA research at Ames; Lewis Research Center in Cleveland; and Langley Research Center in Hampton, Va., plays a major role in this effort.

Citing Foushee's study of cockpit communication, the National Transportation Safety Board recommended to the Federal Aviation Administration that airlines take steps to ensure adequate communication between crew members, particularly in noisy aircraft cockpits. Some airlines already have begun teaching communication and leadership styles in their pilot training courses.

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## Flight Crew Communication

Foushee used data from the 1979 experiment, titled "A Simulator Study of the Interaction of Pilot Workload with Errors, Vigilance and Decisions," conducted for Ames Research Center by Dr. H. P. Ruffell Smith.

Volunteers for the 1979 study were 18 fully qualified Boeing 747 crews. Ruffell Smith asked the crews to fly a realistic, full-mission simulation from New York to London. The simulated flight included all visual and motion cues, normal communications, air traffic control services, weather, closed runways at a diversion airport, a malfunctioning engine and an inoperative autopilot. The crews were forced to return to New York because of the simulated engine problems.

Ruffell Smith and his colleagues found marked differences in the way the 18 crews performed in response to the aircraft malfunctions. They noted shortcomings in communication, as well as in decision making, crew interaction and integration.

Foushee wanted to take a closer look at the conversations recorded during these high workload situations.

Using carefully defined categories, he analyzed crew communication from the simulated flights.

Each communication was coded into one of 10 categories: crewmember observations; commands; inquiries; response uncertainty (verbalizing uncertainty or lack of information); agreement; acknowledgments of a command, inquiry or observation; tension release (laughter or humorous remarks); frustration or anger; embarrassment; pushes (repetitions of commands or inquiries).

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## Flight Crew Communication

In addition to the finding that crews who communicated less performed with less proficiency, Foushee found other correlations:

-- When crews acknowledged commands, inquiries and observations, they made fewer errors. Efficient crews tended to acknowledge communication more often than other crews.

-- Acknowledgments also were associated with fewer misunderstandings related specifically to systems operations -- such as handling of engines, hydraulic and fuel systems, reading and setting of instruments and use of ice protection. Foushee believes acknowledgments reinforce and encourage further communication between crew members.

-- Increased observations about flight status also seemed to enhance crew performance related to systems operations.

-- More proficient crews exhibited more agreement than other crews. Researchers cannot be sure, however, whether the disagreement among crew members caused errors or whether the errors caused the disagreements.

-- Less proficient crews tended to show higher rates of response uncertainty, frustration/anger and embarrassment. But again it is not clear whether this was the cause or the result.

-- The more commands given in the cockpit, the more efficient the crew. Foushee points out, however, that if captains phrase too many communications as commands, they can create an intimidating atmosphere in the cockpit. Such an atmosphere has been shown in accident and incident reports to sometimes prevent subordinate crew members from speaking up in emergency situations.

(more)

May 17, 1982

## Flight Crew Communication

To substantiate his findings, Foushee reviewed reports of real life incidents from the NASA Aviation Safety Reporting System. These reports backed up the finding that poor communication frequently causes deficiencies in the cockpit. (Run by NASA for the Federal Aviation Administration, the reporting system provides a means of identifying potential safety hazards using anonymous reports of aviation incidents by pilots and controllers.)

NASA aviation psychologists continue to investigate the interaction between flight crews, air traffic control and aircraft as part of the Man-Vehicle Systems Research program of the Ames Life Sciences Directorate.

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IMMEDIATE

## EVIDENCE PRESENTED THAT VENUS HAD OCEANS

The searing hot planet Venus at one time had sufficient water to have possibly had oceans 30 percent or more the size of Earth's oceans. This is the conclusion of a University of Michigan atmospheric scientist, Dr. Thomas M. Donahue, writing in the current issue of Science magazine.

Donahue, head of the science steering group for NASA's Pioneer Venus project, initially indicated the potential for a Venus ocean at the November 1981 Venus Conference at Palo Alto, Calif. The Pioneer Project is managed by NASA's Ames Research Center, Mountain View, Calif.

At that time Donahue and colleagues had begun piecing together clues originally obtained during the descent of the Pioneer Venus Large Probe into the yellow planet's lower atmosphere.

The port to the large probe's mass spectrometer became coated with sulfuric acid droplets from Venus' clouds and reliable measurements were not expected to result while the

-more-

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port was clogged.

At the Pioneer Venus conference, however, Donahue and fellow investigators began to discuss the possibility of determining the concentration ratio of deuterium (heavy hydrogen) to hydrogen with the clogged instrument.

The sulfuric acid blocking the instrument port would, it was hoped, contain sufficient traces of Venus water to permit determination of the current ratio of deuterium to hydrogen. Because of the different rates of escape of light hydrogen and heavy hydrogen (deuterium) over geologic time (billions of years), determination of the current deuterium/hydrogen ratio would provide the atmospheric scientists with indications of whether Venus has always lacked water or whether large amounts of water were present early in the planet's evolution but were subsequently lost.

During the conference, Donahue and others reexamined the data from the Pioneer large probe mass spectrometer and later from the Pioneer Orbiters ion mass spectrometer to see if they could obtain good deuterium/hydrogen readings.

(The Orbiter continues to circle Venus and return good data.)

Based on this reexamination of data, Donahue and his colleagues present findings in Science which postulate that the present ratio of deuterium to hydrogen on Venus is on the order of one to 160.

This current ratio coupled with additional estimates of the original ratio of deuterium to hydrogen on Venus -- estimated to

be close to that originally on Earth, or 1 to 15,000 --has led Donahue and colleagues to suggest that originally Venus had an ocean which was lost as a result of hydrodynamic outflowing of hydrogen (diffusion to space). Following a large initial outgassing of water from the planet, Donahue suggests that a runaway greenhouse condition ensued which drove hydrogen from the liquid ocean into the atmosphere from which it subsequently left through supersonic hydrodynamic escape to space. Since this process favors the escape of hydrogen (the lightest element) over heavy hydrogen (deuterium), the deuterium found in the Venus atmosphere today is an observable remnant of the early Venus ocean.

Donahue and his colleagues suggest the minimum amount of water lost from Venus was the equivalent of one third of Earth's oceans, although it could have been more.

These findings present intriguing possibilities for future exploration of the cloud-shrouded planet. NASA is currently studying a radar mapping mission to Venus which could provide topographical evidence of early river channels and oceans.

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*X - media event*

*May 28*

For Release.

Peter Waller 415 965-5091

No. 82-22

IMMEDIATE

To Editors:

*7. "mystery cloud"*

NASA-Ames will present a background briefing on the hemisphere-spanning stratospheric cloud from Mexico's El Chichon volcano, at 10 a.m., Friday, June 4.

A review of findings about the cloud will be provided by experimenters, theorists, and U-2 pilots, who have flown some 700 miles in the cloud. Data on measurements of the cloud from 12 experiments (aboard NASA U-2's, and Ames' Galileo II, Convair 990, airborne observatory) has now been reduced.

Conclusions about total size and density (hemisphere-wide) of the so-called "monster cloud" and possible effects on climate cannot be reached from current data. These conclusions must await a number of measurements from many widely-spaced points in the northern hemisphere. However, those portions of the stratospheric cloud over the southern U.S., Mexico, Hawaii, and Japan can now be characterized much more competely than before. Various assumptions can be made about the cloud's total mass from these samplings.

News people attending the briefing should come to the NASA gate of Moffett Field, and will be directed from there.

For TV, film clips of U-2 flights, and the U-2's themselves will be available.

May 28, 1982

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PM papers

June 17, 1982

No. 82-23

## PIONEERS MAY FIND TENTH PLANET

The two Pioneer spacecraft, the most distant man-made objects in the solar system, may soon detect a tenth planet out beyond Neptune and Pluto--or alternatively a dark star companion to the Sun at perhaps 50 billion miles beyond Pluto.

The Pioneers have unique advantages for such a search, and persistent irregularities in the orbits of Uranus and Neptune strongly suggest that some kind of mystery object is really there--far beyond the outermost planet. (Because Pluto's orbit is greatly elongated, Pluto and Neptune take turns being the outermost planet with Pluto currently inside Neptune's orbit for the next 17 years.)

Pioneer 10 is now between the orbits of Uranus and Neptune, and will be beyond all the planets in July of next year. Pioneer

11 is between the orbits of Saturn and Uranus. The Pioneers are managed by NASA's Ames Research Center, Mountain View, CA.

The discovery in 1978 by Christy and Harrington of a satellite of Pluto (since named Charon) reduces the calculated mass of the Pluto-Charon system to only one fifth the mass of the Earth's moon, and gives Pluto a diameter of 2400 km (1440 mi). This is far too little mass to account for the unexplained tiny but regular shifts in the orbits of Neptune and Uranus. These orbital changes had been attributed to the pull of Pluto's gravity on the two planets.

A large dark-star type object (perhaps the size of the Sun) and perhaps 50 billion miles beyond the outermost planet could produce the orbit shifts measured for Neptune and Uranus. This distance from the Sun is a common one for dark stellar companions of visible stars. A black hole, perhaps ten times the Sun's mass and twice as far out (100 billion miles beyond Neptune) could also account for the measured orbit shifts. Either of these two types of object would produce a general tidal effect in the solar system (an equal gravitational pull) on all the outer planets.

On the other hand, the pull of an undiscovered planet-sized object at perhaps five billion miles beyond Pluto and Neptune would also be consistent with orbit discrepancies for Neptune and Uranus. But these would be "local effects", and gravitational pull would vary markedly with planetary positions.

Since Pioneers 10 and 11 are on opposite sides of the solar system, one spacecraft would feel the pull of a "small and close" planet-sized object far more than the other would. A larger,

more distant body would pull on both spacecraft almost equally. Therefore, measurements of the solar system escape trajectories of the two spacecraft over periods of several months could be used to find out whether the Pioneers were being attracted by a relatively close planet versus a more distant dark star or black hole. Further observations would allow estimates of size and distance of such a planet--as well as its direction. Calculations for this would be based on changes with location in space of the gravity field created by such an outside-the-known-solar-system body.

If the Uranus-Neptune orbit changes turned out to be due to a dark companion star or black hole, presence of such a large body could be verified, and a line through the Sun and solar system could be drawn, which would also pass through the large "mystery body". However, it would not be possible to say from Pioneer data which of two sides of the solar system the body was on. Other types of measurement aimed at locating such a big object might soon be developed, once its presence was known.

While almost any dark celestial object is a possibility, Dr. John Anderson, Jet Propulsion Laboratory, Pioneer celestial mechanics experimenter, suggests that perhaps a dark stellar companion to the Sun might be the most likely explanation. A tenth planet should be at least five billion miles beyond Neptune, unless it was completely out of the pattern of spacing (distances from the Sun) for the other solar system planets (Bode's law). At this distance to produce the measured effects on Uranus and Neptune, it would have to be another giant planet,

as large as Uranus (diameter-29,400 miles) or Neptune (diameter-26,800 miles). If a tenth planet were still farther out, it would have to be even larger, on the scale of enormous Jupiter. Such a large body should be easily visible by telescope, and would have been discovered already. However, if the surface of such a giant planet (of either size) were very dark (unreflective) or far out of the plane containing the other planets, it might be hard to detect visually, and still be undiscovered.

Black holes, so far, are somewhat exotic objects, and only one black hole has been tentatively identified, while dark stellar companions to stars like our Sun appear to be relatively common.

"There is a whole class of objects ranging between a planet and a dark star. It could be any of these, and we are keeping an open mind," says Dr. Anderson. "We know there is a source of systematic variations in the orbits of the two outer planets. Work demonstrating these orbit variations has been done largely at the U.S. Naval Observatory, Massachusetts Institute of Technology, and JPL," he adds.

These Pioneer measurements should be much more effective than continuing measurements of outer planet orbits, since at the least 30 to 50 years of observations would be required, and probably several complete orbits. Pluto requires 249 years to complete an orbit, Neptune, 165 years, and Uranus, 84 years. All these are time periods so lengthy that they provide difficulties for practical observations. Several years of Pioneer

measurements should provide essentially the same information.

The Pioneers have a further advantage in that they are stabilized by their five rpm spin, rather than by the orbit-changing push of thruster systems. This means their precisely-known trajectories are shaped almost entirely by natural forces, and have been for many years.

Dr. Anderson believes measurements of the Pioneer orbits could detect a gravity force from outside the solar system as minute as one trillionth kilometer per second per second, or even one ten trillionth.

Measurements of Pioneer's position are made by two-way Doppler. A two-way radio signal is sent to the spacecraft at a known frequency. Changes in frequency of the returning signal due to the "Doppler effect" give changes in spacecraft velocity away from Earth to a fraction of a millimeter per second. Plotted continuously, these velocity changes give the exact spacecraft trajectory relative to the known exact locations of the Sun and planets. Unexpected velocity changes suggest the presence of another body.

Celestial mechanics methods (like those just described) have been used to find other outer planets. Differences between the real orbit of Uranus and its calculated orbit led to finding Neptune in the 19th century. Percival Lowell and William Pickering used Uranus-Neptune data to compute a hypothetical orbit for Pluto, although Clyde Tombaugh actually found Pluto in 1930 through a painstaking search of thousands of star photos.

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IMMEDIATE

No. 82-24

## Balloon Drop Test for Jupiter Atmosphere Entry Spacecraft

A high-altitude balloon-drop test of the Galileo Atmosphere Probe spacecraft, which will make the first descent into the atmosphere of Jupiter, is scheduled for the week of June 13, at White Sands Missile Range, New Mexico.

The Galileo probe will be launched to Jupiter in 1985. It will reach the planet in 1989, and fly 100 miles down into the atmosphere of the giant planet, penetrating below the swirling clouds to a pressure level 20 times higher than that on the Earth's surface. This will be the first direct sampling of the atmosphere of any outer planet. Scientists are extremely curious about the composition of Jupiter's atmosphere, for what it tells about the solar system and about giant Jupiter itself.

At the drop altitude, the spacecraft (consisting of the Galileo Deceleration Module and the Descent Module) will separate

from the balloon. As it drops, it will experience speeds and deceleration pressures virtually identical to those it is expected to encounter in Jupiter's atmosphere. Purpose of the high-altitude test will be to demonstrate the Galileo parachute deployment sequence, and separation of Deceleration Module from the Descent Module.

The balloon drop will be made from about 100,000 feet above the Earth (19 miles). The polyethylene balloon has a 5.14 million cubic foot capacity. Air Force technicians will launch the balloon from Roswell, N. M. After launch, the balloon is expected to float 120 miles westward over the Army's White Sands Missile Range, where telescopes and cameras will record the Galileo probe deployment and separation. Telemetry will monitor key mission events.

During the test, a small pilot chute separates the aft cover from the Deceleration Module, and extracts the large main parachute. The rest of the Deceleration Module (heat shield and aeroshell structure) then separates from the Descent Module, which completes the flight, descending on the parachute.

The Descent Module will carry instrumentation to monitor various mission events and performance. It will also radio data to the ground, carry a programmer to initiate various events, plus cameras, batteries for power, a radio beacon for ground recovery, heaters and thermostats for temperature control.

The balloon will carry a recoverable gondola to house the Galileo probe hardware, and provide pre-drop power, heating, movie cameras to record the drop, and other balloon-related

equipment.

Balloon filling with helium gas at Roswell, N.M. is expected to take one to two hours, with release at about sunrise. The ascent and subsequent 120 mile flight to the drop zone will take from two to eight hours depending on the winds.

Project management for the Galileo probe system is by NASA's Ames Research Center, Mountain View, CA. Hughes Aircraft Co., El Segundo, CA is the prime system contractor responsible for design and development of the spacecraft. General Electric Co., Philadelphia, is providing the forward and aft heat-shields and deceleration structure system, including parachutes, as well as serving as balloon drop test coordinating contractor.

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6-11-82

# NASA News

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**Ames Research Center**  
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Evvie Rasmussen 415-965-5091

For Release:

Release No. 82-26

IMMEDIATE

(Photo No. AC81-0781-3)

## AIRBORNE OBSERVATORY YIELDS DATA FOR MAP OF ORION NEBULA

A map of the Orion Nebula, which demonstrates newly formed stars not visible to the naked eye, has been created by scientists using infrared data obtained from NASA's Gerard P. Kuiper Airborne Observatory.

These stars have been under study by infrared astronomers since their discovery some 15 years ago. Total power output of this group of very young stars is more than 100,000 times the power of our sun, infrared observations have shown.

The most recent infrared observations were made by a team of astronomers, led by Dr. Michael Werner of NASA's Ames Research Center, using the Kuiper's 91.5-cm. (36-in.) telescope. Ames operates the Kuiper Airborne Observatory as a national research facility.

The map shows how the nebula would appear through a large telescope sensitive to infrared. The infrared image was superimposed on a black-and-white photograph provided by the University of California's Lick Observatory.

(more)

June 15, 1982

## Orion Nebula

The stars, which formed within the last 100,000 years ("new" in astronomical terms), are located at the peak of infrared emission, in the central region of the dense cloud of dust and gas outlined by the distribution of infrared emission.

The newly formed stars correspond with a bright spot (seen as pale gray-blue and light purple) to the upper right of the cluster of bright visible stars near the center of the image. The visible stars (known as the Trapezium cluster) heat and excite the gas in the nebula, which can be seen glowing on longer exposure photographs.

The new stars, which are hidden to the eye by the cloud of dust and gas, formed when a portion of the cloud collapsed under its own gravity. They are detectable in the infrared because they heat the surrounding dust which re-radiates their power as infrared or "heat" radiation. Recent observations at infrared and radio wavelengths of the gas in the vicinity of the cluster have shown that it is in a state of violent motion, stirred up by the tremendous energy input from the recently formed stars.

These motions will inevitably lead to the dissipation of the cloud within which the stars formed. The stars will emerge many years in the future to become visible to the eye, joining the nearby Trapezium cluster to create an even larger and more spectacular Orion Nebula.

Orion, a constellation on the equator east of Taurus, is represented on charts by the figure of a hunter with belt and sword. The nebula, located near the middle star of Orion's sword, is 1,500 light years from Earth -- one of the closest

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known regions in the galaxy where stars are forming at the present epoch.

The Kuiper Airborne Observatory is a Lockheed C-141 Starlifter aircraft, equipped with a 91.5-cm. (36-in.) aperture Cassegrain-type reflector telescope which is installed in an open cavity recessed into the port side of the aircraft immediately ahead of the wing. The telescope can be moved in flight over an elevation range of 35 to 75 degrees. It is capable of tracking celestial objects to an accuracy of less than two arc seconds by use of precision gyroscopes and an active digital tracking system.

The team of scientists aboard the Kuiper included astronomers from California Institute of Technology, University of Hawaii and the United Kingdom Infrared Telescope. Color version of the infrared map was created by Allan Meyer, tracker-operator for the Kuiper Airborne Observatory.

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For Release:

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No. 82-27

To Editors:

NASA Ames will hold a briefing on Thursday, June 17 at 10:00 a.m. on the likelihood of the Pioneers' finding a giant tenth planet or dark stellar companion to the Sun.

As Pioneer 10 approaches the orbit of our outermost planet, current celestial mechanics analyses show that Pioneers 10 and 11, on opposite sides of the solar system, are uniquely fitted to locate such a far outer solar system body. Recent findings on the mass of Pluto and systematic variations in the orbits of Uranus and Neptune strongly suggest the presence of some type of outer body--a solar companion, a giant far outer planet, or even a black hole.

For television, TV tapes of the planets, the Pioneers, and other celestial objects will be available, as well as a Pioneer model and pictures of the planets.

News people planning to attend should come to the NASA gate of Moffett Field and will be directed from there to the Building 245 auditorium.

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## NEW TECHNIQUE TRAINS AIRLINE CREWS TO MANAGE PROBLEMS

Modern developments in flight simulation have made possible the design of a unique training exercise for airline crews.

Called Line-Oriented Flight Training (LOFT), the training technique combines an advanced aircraft simulator with a highly structured script to simulate a total operational environment for flight crews.

These realistic simulations give pilot and crew the feeling of actually flying a mission, providing an opportunity for them to deal with problems which might arise in flight. The technique has been found superior to the practice of discrete maneuvers.

The Federal Aviation Administration (FAA) has recommended that this specific training program become part of all airline training programs. Guidelines for Line-Oriented Flight Training were put together by NASA Ames Research Center aviation psychologists Dr. John K. Lauber and Dr. H. Clayton Foushee from materials developed at an Ames-hosted workshop in 1981 which involved FAA, industry and NASA representatives.

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These guidelines now have been incorporated into the FAA recommendations, distributed to all training personnel from United States and foreign carriers.

Aeronautical research is a continuing focus of work at three NASA centers: Ames; Langley Research Center Hampton, Va.; and Lewis Research Center in Cleveland.

Line-Oriented Flight Training involves a complete crew working through simulated real-world incidents unfolding in real time. Consequences of crew decisions and actions during a session accrue and impact the rest of the trip in a realistic manner.

This sense of realism, the most important aspect of the training program, is achieved by constructing scenes with great attention to detail. The more realistic the situation, the faster crews start thinking and reacting as if they were conducting an actual line trip.

Pilots have noted that in a well-conducted Line-Oriented Flight Training scenario, they virtually forgot they were in a simulator. In some cases simulation was so real crews actually shined flashlights on the windshield to look for ice.

Such realistic scenarios required the development of advanced simulators that could provide operation and handling qualities recognizable as those of a specific airplane. They required simulation of ground facilities, navigational aids and airports, as well as visual systems capable of producing realistic visual cues.

The program provides training in judgment and decision-making. Problems are presented which have no single acceptable

(more)

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solution, forcing crews to think about ways they make decisions under pressure. Errors are expected. Line-Oriented Flight Training is an exercise in the management of human error, not a checking program in which errors are unacceptable.

NASA's involvement with the training program began with an experiment carried out at Ames in 1976 by H.P. Ruffell Smith, a British researcher who wanted to study human factors in aircraft operations.

Ruffell Smith used a training simulator together with carefully structured, detailed trip scenarios to expose crews to a specific set of operational problems similar to what they might encounter during scheduled line operations.

The study was designed specifically for human factors research, but implications for training soon became obvious to researchers. In fact, volunteer crews who participated often noted training benefits of the experiment.

At about the same time, Northwest Orient Airlines asked the FAA for permission to try a new type of training which involved full-mission simulations. The FAA granted permission, and after noting the success of the Northwest program, suggested other airlines try this type of training. More recently, the FAA has recommended that a LOFT-style program be part of every airline's training system.

NASA's aviation psychologists study the interaction between flight crews, air traffic control and aircraft under the Man-Vehicle Systems Research Division of the Ames Life Sciences Directorate.

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IMMEDIATE

No. 82-30

(This story is also being released by the U.S. Army Public  
Affairs Office, White Sands Missile Range, New Mexico)

## Galileo Probe Balloon Drop Test Successful

NASA project scientists studying preliminary data received from Saturday's (July 17) Galileo atmosphere probe spacecraft test over White Sands Missile Range say the program was successful.

Dropped from a balloon flying 97,000 feet above the range the Galileo probe impacted at 10:25 a.m., about eight miles south of the White Sands Space Harbor (formerly Northrup Strip) control tower. It had been airborne for about four hours after launch from Roswell, N.M., some 120 miles east of the impact point.

The balloon-drop probe test originally had been scheduled for early last month, but a combination of unfavorable weather, technical problems and range scheduling delayed the operation until last weekend.

Galileo project manager Joel Sperans of Ames Research Center, Mountain View, California, reports a quick look at on-board camera data indicates the probe's entire descent sequence

worked properly. He said the successful test was a major milestone in the development of the atmosphere probe spacecraft designed to sample the planet Jupiter's atmosphere in 1989.

He indicated several weeks will be required to analyze all the data received, including the yet-to-be processed ground based electronic and optical data.

The main parachute did open slowly, but according to Sperans, the one-second discrepancy probably will be no problem. Although the data received has yet to undergo a complete study, the project manager said no future tests are planned.

An Ames research spokesman indicated all the sub-systems of the Galileo probe will be integrated and tested in 1983, and the system ready for launch in 1985.

If this time table is kept, the probe will reach the planet in 1989 and fly 100 miles down into the atmosphere of the giant planet. It is slated to penetrate Jupiter's swirling clouds and in the process experience a pressure level 20 times higher than that on Earth's surface.

The probe will be the first direct sampling of the atmosphere of any outer planet. According to the Ames spokesman, scientists are extremely curious about the composition of Jupiter's atmosphere for what it tells about the solar system and about Jupiter itself.

Detachment 1, Air Force Geophysics Laboratory, assigned at

Holloman Air Force Base, launched the 5.14 million cubic foot capacity carrier balloon from Roswell at about 6:25 a.m. July 17.

Four hours later the Galileo probe was dropped over the Army's sprawling missile range where camera equipped telescopes and radar recorded the probe's separation from the balloon and the deployment of its parachute system.

Following separation from the balloon, the Galileo deceleration module's pilot chute deployed, removed the aft heat shield and extracted the large main parachute as programmed.

The remainder of the deceleration module (heat shield and aeroshell structure) experienced a nominal separation from the descent module. NASA officials said some ballast in the balloon-borne test failed to separate from the descent module during the test, however, this poses no problem during the descent to Jupiter.

As deceleration and descent modules separated from the balloon, both experienced speeds and deceleration pressures virtually identical to those expected to be encountered in Jupiter's atmosphere.

July 30, 1982

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# NASA News

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RELEASE NO: 82-31

## NASA STUDIES VOLCANIC CLOUD FOR ITS EFFECTS ON WEATHER

NASA centers in Virginia and California, using the latest electronic sensing systems, are studying a widespread atmospheric gas and dust cloud spewed from a Mexican volcano to determine its potential effects on global weather patterns.

The giant cloud, thrown into the stratosphere by the El Chichon eruption in March and April, now covers much of the Northern Hemisphere. However, because of the natural variance and complexity of worldwide climate patterns, any effects the cloud might have would only become apparent in retrospect after scientists have examined current weather patterns.

Data gathered about the cloud now will provide the information base for later correlation between current weather changes and the cloud's movements and density during those

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weather changes. The cloud studies are part of NASA's Aerosol Climatic Effects Program. This ongoing examination of the atmospheric effects of gaseous discharges is coordinated by Dr. James Pollack of NASA's Ames Research Center, Mountain View, Calif., and Dr. M. Patrick McCormick head of the Aerosol Research Branch at Langley Research Center, Hampton, Va.

To study the cloud, NASA is using satellites, U-2 aircraft and LIDAR (Light Detection and Ranging).

"This new stratospheric injection represents a once-in-a-lifetime chance to test various physical models that predict dispersion, temperature change, and dynamic and photochemical changes," said McCormick. "It's an amazing set of data. We have never observed this amount of material or at these heights from past eruptions."

The cloud is a mixture of dust and sulfuric acid. The sulfuric acid will provide spectacular sunsets for a few years after an eruption. However, the dust soon settles out. Sulfur dioxide from the volcano has combined with water to form sulfuric acid, which is highly reflective. These droplets remain in the stratosphere for as long as two years, absorbing thermal energy from the earth, thus warming the stratosphere, and reflecting sunlight, thus cooling the atmosphere below.

Satellite measurements revealed substantial amounts of sulfur dioxide in the eruption cloud. Some gases may yet remain, so it could continue to grow as well as spread.

Cooling attributed to volcanic clouds has had dramatic results on occasion in the past. An eruption in Indonesia in

1815 caused summer snowfall in New England in 1816, which became known as the year without a summer. It is not known now whether the El Chichon cloud is as large or as potentially disruptive.

LIDAR, mounted in a specially equipped Lockheed Electra aircraft, shoots laser pulses into the atmosphere and receives reflections back, "painting" the spatial and vertical extent of the cloud layers above the aircraft.

LIDAR flights made July 8 to 13 revealed several separate layers of material, the top one reaching as high as 33 kilometers (20 miles). The measurements, which confirmed earlier NOAA findings, also showed that the volcano put as much as 50 times (500 times in localized areas) the normal amount of aerosols into the upper atmosphere; that the layers have spread to different latitudes, depending on altitude; and that sunlight reaching different parts of the earth's surface could be reduced by at least several percent.

U-2 flights were conducted in May and July from Ames Research Center. The July flights at high altitudes along the coast of Baja California have shown that the cloud is predominantly composed of sulfuric acid droplets about one-ten-thousandth of an inch in diameter.

While scientists believe any climatic changes caused by the cloud will be subtle, climatically sensitive regions may be affected more noticeably in the short term.

Stratospheric heating could be the first effect observed. The cloud is absorbing thermal radiation, which could raise the stratosphere's temperature by as much as 5 degrees or more. The

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cloud is also reducing the amount of solar energy reaching the ground.

Dr. Brian Toon, an atmospheric physicist at Ames, said that the most likely effect of the cloud could be a gradual temperature reduction of one half to 1 degree Fahrenheit in the Northern Hemisphere over the next two years.

Such a temperature reduction would be significant, but normal atmospheric variations could mask or accentuate the change.

Differential atmospheric heating in areas "shaded" by the cloud might also have significant effects. Various measurements already suggest about a 5 percent reduction in sunlight in the tropics from the cloud, a significant heat loss.

With the instruments available today, scientists hope to gain a much better understanding of the effects of such clouds than was possible in the past. One suspected effect observed decades ago is a possible link between volcanic clouds and early frosts for the two years following a large eruption -- a potentially significant observation for high-latitude areas with short growing seasons.

However, NASA scientists are not predicting an early frost or a shortened growing season or any dire occurrences.

Scientists estimate the cloud is 9.6 km (6 mi.) thick, on average, and between 21 to 33 km (13 to 18 mi.) in altitude. It appears to girdle the earth over more than 30 degrees of latitude, from south of the equator to as far north as Japan and across the United States-Mexican border. The cloud will spread

over this country and Europe during the coming months and should eventually cover the entire Earth. The cloud should remain over the Earth for the next two years, though it will be gradually dissipated.

The cloud's lower layers move generally west to east, but wind shears high in the atmosphere are moving the top layers in the opposite direction. Several layers, however, are "sloshing around," according to McCormick, because of varying winds.

"Eventually, all the layers will be ubiquitous," McCormick said, "smeared out over most of the globe, with higher concentrations in the Northern Hemisphere."

NASA U-2 aircraft have flown in the cloud as high as 18,300 meters (60,000 feet) and reported that, by contrast, the 1980 Mt. St. Helens cloud could easily be seen and dissipated in a few days.

For a volcano's high-floating material to have an effect on earth's temperature, McCormick said there must be two conditions: "There must be a lot of material, and it must stay around a long time because the Earth's surface, especially the oceans, have a lot of inertia."

"This is going to be a perfect case study to check mathematical models that exist on disturbances in temperature caused by an upper atmospheric layer of material, models that predict movement of material in the upper atmosphere, and general climate models," he concluded.

Scientists from NASA, NOAA and several universities will continue to study the cloud as it spreads.

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For Release

Release No. 82-32

IMMEDIATE

## NASA RESEARCH YIELDS INFORMATION ON HUMAN RHYTHM CYCLES

Scientists at NASA's Ames Research Center are studying the body's circadian (24-hour) rhythms to prepare for extended space missions, where small groups of people will be subjected to weightlessness, rapid shifts in light/dark cues and social isolation.

All three of these conditions have been found sufficient to disrupt daily rhythms, according to NASA's Dr. Charles Winget, an Ames physiologist who has studied circadian rhythm in groups placed in social isolation, in shift workers and in humans subjected to prolonged bedrest (a means of simulating weightlessness on Earth).

Understanding the effects of these conditions is important, Winget said, because such conditions on Earth were associated with boredom, irritability, negative moods and withdrawal. Circadian desynchronization (upsetting of 24-hour body rhythms) may also cause fatigue, decreased performance, insomnia, anxiety, gastrointestinal and other physical symptoms.

(more)

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On Earth most humans maintain a basic 24-hour cycle, undisturbed until a crossing of time zones (jet lag), an alteration of work hours, or a late night disrupts the cycle.

Upset rhythms then cause problems with physical health, emotions, behavior, sleep, altered responses to medication and decreased performance. Many people are more susceptible to colds, viruses and infections when their rhythms are disrupted. Headaches and intestinal disturbances are more common during these times.

Daily rhythms are linked to the light/dark cycle of Earth, which sets these internal rhythms. Rhythms appear to be a natural function of cell-formation cycles in the body -- cancer cells are the only cells which don't exhibit rhythms.

Pulse rate, blood pressure, heart rate, temperature, kidney function, metabolism and hormone secretions all follow a pattern and rhythm. (The first three are lower at night. Temperature is low in the early morning and high in the late afternoon; most people perform best when their temperature is highest -- usually about 3 p.m. Kidney function is high during the day and low at night. Metabolic activity is highest at noon. Adrenal rhythms vary, but are higher during early sleeping hours.)

Drugs and alcohol affect the body differently at various times of day. The same amount of alcohol taken early in the morning will result in a higher blood-alcohol level than if taken at about 4 to 5 p.m. -- the optimal time for alcohol consumption.

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Medications, like alcohol, vary in their effect depending on the time of day administered. An oral dose of antihistamine given at 7 a.m. will last 15 to 17 hours, but given at 7 p.m. will last just six to eight hours. Digitalis (a heart medication) has twice the effect when given at night.

Drugs can be given in lowered doses if properly timed -- especially important for powerful cancer medicines with strong side effects. A new field of biology, called chronopharmacology, was developed by Winget and others to study the effects of drugs administered at different times of the day.

Emotional and psychiatric disorders are also associated with upsets in circadian rhythm. Experimental subjects have reported a deep sense of depression and hopelessness within 72 hours of a shift in circadian patterns. Most individuals react to circadian disturbances with lowered self-esteem.

Psychological problems may be associated with sleep difficulties, which are a side-effect of circadian disturbance. When sleep stages are altered, the individual may sleep for an adequate number of hours but the altered rhythm of sleep leaves him unrefreshed, listless and vaguely uncomfortable.

In experimental subjects, temperature and brain waves became abnormal during circadian disruptions and neither measure returned to normal in less than two weeks. Winget concludes from these and other findings that work schedules should not be shifted more often than every three weeks. Otherwise the worker is continuously deprived of normal, health-giving sleep patterns, and performance and safety awareness inevitably decrease.

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Studies of humans isolated in small groups have shown that social interaction affects rhythm. Rhythms for individuals in a small group tend to synchronize together and change when new individuals are introduced into the group.

Winget recommends the following guidelines for coping with an upset in circadian rhythms:

- Perform the most important tasks as soon after waking as possible.

- Avoid working with power tools or driving a vehicle when feeling sleepy or disoriented.

- Eat the largest meal of the day as soon as possible after waking.

- Decrease caloric intake slightly and avoid overloading the system with food.

- Decrease intake of salt, coffee, beer, wine and hard liquor. Caffeine can help increase performance, but only when taken at peak times -- such as the high point in the temperature cycle.

- Use only prescribed medications. Amphetamines and sleeping pills won't help, because of their "hangover" effect and because they disturb "REM" -- Rapid Eye Movement -- sleep (dreaming), which is important to human psychological well-being.

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Release No. 82-34

## NASA'S U-2 AIRCRAFT TO MAP LIGHTNING

An experiment designed at the Marshall Space Flight Center, Huntsville, Ala., to aid in the development of a sensor system to "map" lightning from space will be flown aboard a NASA U-2 aircraft this month.

Marshall scientists left last week with the experiment package for Ames Research Center, Mountain View, California to prepare for the flight. Ames is the home of three high altitude Earth Resources Survey Aircraft -- two U-2 aircraft and a newer, larger ER-2.

According to Hugh Christian, project scientist at Marshall's Space Sciences Laboratory, the Optical Lightning Detection Experiment will measure optical "signatures" of lightning from above thunderstorms.

This experiment complements the Nighttime/Daytime Optical Survey of Lightning which was taken into space on the second and fourth flights of the Space Shuttle to provide a wide field of

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view from orbit. The U-2 flight provides for use of more sensors, larger cameras and a longer duration over a single storm system.

This U-2 flight is the seventh in a series of flights over the tops of thunderstorms to look at the relationship between storm severity and lightning activity, how lightning rates correspond to cloud top motions and measure the amount of lightning occurring in severe storm systems. "The measurements are necessary for the development of a lightning mapper which could enhance our knowledge of lightning-related weather phenomenon once it is installed in a geostationary weather satellite," said Christian.

"The major problem which must be solved before such a lightning mapper could be installed in a geostationary weather satellite is detecting the lightning in the daytime," he said. "The light reflecting off the tops of the clouds is brighter than the lightning emissions. We are studying several approaches to filtering the light in order to detect the weaker flashes.

"This may be a good way to track a severe storm in real time, or 'nowcasting' as opposed to forecasting. Large amounts of lightning may provide immediate indications of a severe storm before long-range radar would indicate it," Christian said.

The overflight with the U-2 plane will provide opportunities for the experiment during an eleven day period which began August 9 on a target of opportunity basis. "We will fly when we have a good storm," he said.

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The experiment, consisting of seven sensors, is mounted on a pallet which fits into the belly of the plane.

The U-2 aircraft flies at 740 km/hr (400 knots) at an altitude of 65,000 feet and can remain aloft for up to six hours at a range of 4,700 km (2,500 nmi). The U-2 and ER-2 aircraft were built by Lockheed-California Company, Palmdale, Calif.

Otha Vaughan is a co-investigator on the experiment and Larry Frost is responsible for the engineering aspects of the experiment. Both are with Marshall's Space Sciences Laboratory. The U-2 aircraft are part of the Ames High Altitude Missions Branch, managed by Jim Cherbonneaux.

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August 18, 1982

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Release No. 82-37

IMMEDIATE

## A CLOSE ENCOUNTER OF VETERAN SPACECRAFT

Two of NASA's most venerable spacecraft, Pioneers 8 and 9, will have a close encounter by space standards when they pass within 1.5 million miles of each other on Thursday, Oct. 7. The still-operating solar satellites have been circling the Sun like miniature planets since 1967 and 1968.

Two similar spacecraft that predate these sister ships are Pioneers 6 and 7, launched in 1965 and 1966. Also in solar orbit, they are still transmitting information on the space around the Sun.

Designed to last at least six months, these four Pioneer craft have far exceeded expectations. They have been orbiting the Sun a total of 62 years, and have collectively traveled over 36 billion miles through space. Pioneer 6 is man's longest-lasting craft in interplanetary space.

Together the four spacecraft make up a network of solar weather stations which circle the Sun. Despite occasional equipment malfunctions, the rugged satellites transmit magnetic and electric fields of the Sun and planets, and the high energy

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cosmic ray particles in space.

These early Pioneers are tracked by NASA's Deep Space Network only when other more modern missions don't interfere. However, data on current solar activity maintain its interest.

Data from Pioneers are transmitted to radio engineers, to space scientists, and to the "solar weather forecasters" of the National Oceanographic and Atmospheric Administration's Solar Disturbance Forecast Center at Boulder, Colo. Their data are made available to a range of users.

When Pioneer 10 passed near Pioneer 9 on its way to Jupiter in 1972, Pioneer 9 was tracked by NASA's space antennas during increased solar flare activity. Changes in the solar material were documented as it traveled the 279 million miles between Pioneers 9 and 10.

Two of NASA's antennas, located in Australia and Goldstone, Calif., will be listening Oct. 10 when Pioneers 8 and 9 are still close together. Their simultaneous signals will help scientists compare the interplanetary medium in relatively close locations, as well as assess the precision of the information the two solar satellites transmit.

During the upcoming encounter, specific tests will be done to check the recalibration of Pioneer 8's solar wind instrument, which had been damaged shortly after launch. Transmitted measurements of the one-million-miles-per-hour solar winds will be compared to those from an identical instrument on Pioneer 9, about an hour and a half (1.5 million miles) "upwind."

The October encounter is the result of the positions of the

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crafts in their solar orbits, which average about 180 million miles across. Pioneer 8 will be at its point closest to the Sun (the perihelion of its orbit) at the same time Pioneer 9 is swinging out to its farthest position from the Sun (the aphelion of its orbit).

Pioneer 8, launched Dec. 13, 1967, orbits the Sun every 388 days, mostly outside the Earth's own solar orbit. Its orbit varies from 0.99 to 1.09 Astronomical Units from the Sun. An Astronomical Unit (AU) is the average Sun-to-Earth distance, or 93 million miles.

Pioneer 9 has been circling the Sun every 298 days since its launch Nov. 8, 1968. Its orbit, which is primarily within the Earth's solar orbit, swings from 0.75 to 0.99 AU from the Sun.

There have been 15 prior occasions when Pioneers 6-9 have traveled near one another in space, but they have been no closer than 8 million miles apart.

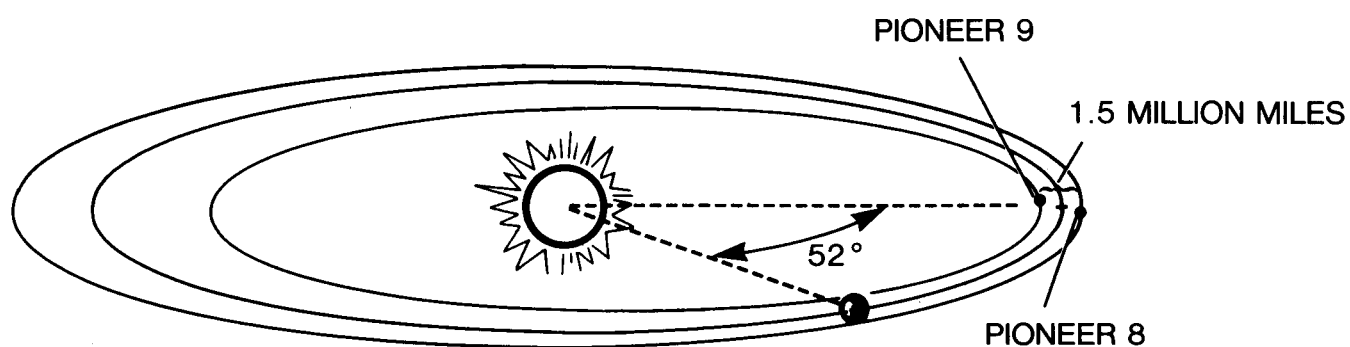
In comparison, the 1.5 million miles that will separate Pioneers 8 and 9 is a short hop through space, though it is approximately seven times the average distance between the Earth and the Moon.

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October 4, 1982

# POSITIONS OF EARTH AND PIONEERS 8 AND 9

OCTOBER 7, 1982



# NASA News

National Aeronautics and  
Space Administration

## Ames Research Center

Moffett Field, California 94035  
AC 415 965-5091

Evvie Rasmussen 415-965-5091

For Release:

Release No. 82-38

IMMEDIATE

### NEW SATELLITE TECHNOLOGY TESTED FOR USE AS TOXIC WASTE MONITOR

NASA is using the latest remote sensing satellite technology to study hazardous-waste disposal sites north of San Francisco Bay.

The four-year study, a joint research project of NASA's Ames Research Center and Woodward-Clyde Consultants in San Francisco, is designed to test the technology of the new Thematic Mapper, launched in July aboard NASA's Landsat-4 satellite.

The Thematic Mapper data is being tested for its use in assessing hazards from more than 20 waste disposal sites located in the Carquinez Straits of San Pablo Bay, the northern extension of San Francisco Bay. Researchers identified existing and abandoned sites using information provided by the California Department of Health and the U.S. Environmental Protection Agency.

The Carquinez Straits area has historically had a high concentration of major industrial facilities because of its proximity to railroad lines and deep water ports. These industries generated and discarded a considerable amount of waste

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October 13, 1982

-- often on private property within an industrial facility, which made regulation difficult.

Thematic Mapper data will be used to study the area for water quality, stress on vegetation, land use, soils, surface geology, and topography. Geologic hazards and proximity to populated areas also will be assessed.

Using the data, researchers will analyze potential waste hazards to nearby urban areas. They will identify effects of waste on bay water by looking for signs of turbidity, chlorophyll concentration (an indication of abnormal algal growth), and distribution of heated waters entering the bay.

Geologic faults will be assessed for their potential to cause leaks of toxic materials from hazardous-waste disposal sites. Criteria will be developed to determine buffer zones around hazardous sites -- zones where further development should be limited.

Once the Carquinez Straits study has been completed, NASA scientists, in conjunction with a Woodward-Clyde project for the Department of Energy, will test the techniques at a site in southeastern Utah. Techniques developed in the Carquinez Straits study will be used to assess compatibility of Thematic Mapper data with a geographic information system for the Utah project.

The Thematic Mapper is a high-resolution, multispectral scanner system which observes the Earth in seven bands of light in the visible, near infrared and thermal infrared range. The mapper's greater spectral and spatial resolution is expected to provide superior maps of geologic and environmental features compared to earlier Landsat sensors.

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Until the satellite data become readily available, researchers are working with a Thematic Mapper simulator -- an aircraft-mounted instrument with characteristics similar to the Thematic Mapper aboard the satellite. The aircraft sensor is designed to approximate the resolution of the Landsat Thematic Mapper system at its orbital altitude of 705 kilometer (438 miles) while flying at 19.8 km (65,000 feet) in the NASA Ames U-2 aircraft.

The newest Landsat provides a tool for acquiring reliable physical site information in a timely and cost-effective manner. Circling the earth every 98.9 minutes, Landsat-4 images the same 185 km (115 mi) swath of the earth's surface every 16 days. During those 16 days any part of the earth, except a small area around the poles, can be imaged by the instruments aboard.

Dr. David Mouat of the NASA Ames Technology Applications Branch is manager of the toxic waste project. He is assisted by Leslie Morrissey, team leader for Technicolor Government Services (TGS -- an Ames contractor) and Elizabeth Horn, a primary data analyst for TGS. Program directors for Woodward-Clyde are Catherine Kitcho and Richard J. Woodward, III, of the San Francisco office.

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# NASA News

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Evvie Rasmussen 415-965-5091

For Release

Release No. 82-39

IMMEDIATE

## WOMEN TO BE TESTED FOR EFFECTS OF SIMULATED WEIGHTLESSNESS

Eight women aged 30 to 45 will be tested in October at NASA's Ames Research Center for the effect of weightlessness on body fluids.

Weightlessness will be simulated by seven days of bed rest with the head lowered six degrees from the horizontal -- marking the first time women have been tested in this "head-down" position.

Third in a series of four experiments, the study is being conducted by Dr. Joan Vernikos-Danellis, a pharmacologist in the Ames Biomedical Research Division.

Prolonged horizontal bed rest has long been used in the United States as an effective way to simulate the weightless condition of spaceflight. Vernikos-Danellis uses the head-down method, preferred by Soviet scientists, because it provides a better simulation of the rush of blood to the head which occurs on initial exposure to weightlessness. Scientists believe it is this rush of blood which triggers the body mechanisms that eliminate fluids and salts.

(more)

October 18, 1982

After preliminary screening tests, eight volunteers will be selected for admission Oct. 27 to the Ames Human Research Facility. The women will be subjected to five days of controlled activities, followed by seven days of bed rest. Subjects will be discharged Nov. 14, three days after getting out of bed and returning to ambulatory status.

Vernikos-Danellis conducted an identical test with eight men aged 35 to 50 last October and a similar study with another eight men in August 1980. She will study another group of eight women next year to complete the series of experiments.

Preliminary findings from the first two studies show that the human body reacts to simulated weightlessness in a manner that is opposite the way it reacts each time a person gets out of bed. The response to the rush of blood to the head during the first 24 hours of simulated weightlessness is a mirror image of the body's response to the rush of blood to the feet each time a person stands up.

When a subject stands up after just one hour of lying down, his heart rate increases, blood volume decreases and fluid-retaining hormones increase. The response to standing up after seven days of bed rest is merely a magnification of the normal body response to standing up after just one hour in bed.

The two head-down bed rest studies of males indicated that hormone mechanisms regulating fluid retention are suppressed during the first 30 minutes in this position, causing more fluid to be eliminated from the body. The hormones continue at a decreased level for 24 hours, when they return to a new normal adaptive level.

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Although excessive fluid loss is only apparent for the first 24 hours, salt loss continues. For the duration of the bed rest, the body eliminates more salt than it takes in.

Loss of excess fluid apparently is a normal adaptation to the weightless environment or the head-down posture, but it also contributes to the general deconditioning of the body, making some persons more likely than others to faint when they get up after seven days of head-down bed rest. This tendency may also be a problem for some individuals during reentry and post-flight readjustment to Earth's gravity.

Vernikos-Danellis has three co-investigators for these studies: Dr. L.C. Keil of Ames, Dr. Mary Dallman of the University of California Medical School in San Francisco, and Dr. Victor Convertino of the University of Arizona.

The Ames Biomedical Research Division is directed by Dr. Harold Sandler. The Ames Human Research Facility is managed by Dee O'Hara, R.N.

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# NASA News

National Aeronautics and  
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Ames Research Center  
Moffett Field, California 94035  
AC 415 965-5091

10/9/82

For Release:

Peter Waller 415-965-5091

Rel. No. 82-40

IMMEDIATE

## Ames Deputy Director

### Named AAS Fellow

Angelo Guastaferro, Deputy Director of NASA's Ames Research Center, Mountain View, CA, has been named a Fellow of the American Astronautical Society (AAS). The AAS is the leading U.S. scientific and technical organization devoted to space activities. AAS Fellows are the highest ranking members of the Society, selected for significant contributions to astronautics. New AAS Fellows will be presented at the AAS awards luncheon, Oct. 27, Houston, Texas.

As Ames Deputy Director, Guastaferro has a range of management and technical duties. He has had a long career in space and aerospace project work since receiving his Bachelor's degree in Mechanical Engineering from New Jersey Institute of Technology in 1954. He received an MBA in Research and Development Management from Florida State University in 1963.

From 1955 to 1963, he served as an officer, and then as a civilian, with the U.S. Air Force Armament Center at Eglin Air

Force Base in Florida as an aeronautical project engineer. He began his NASA career at the Langley Research Center, Hampton, VA in September 1963. He served at Langley in a variety of research and development management positions including Scout Mission Operations Manager, Viking GCMS Manager, Viking Deputy Project Manager, Rotor Systems Research Aircraft Project Manager, and the Large Space Systems Technology Program Manager.

In April 1979, he went to NASA Headquarters, where he headed the Planetary Division, Office of Space Sciences, responsible for the planning, development, and operation of spacecraft systems for planetary exploration. At Langley, he received Special Achievement Awards in 1974, 1977, and 1978, and a NASA Outstanding Leadership Medal in 1977 for work on Viking. At NASA Headquarters, he received the NASA Exceptional Performance Award in 1980. In 1981, he received the NASA Exceptional Service Medal for work on the Voyager Project.

Guastaferro is married to the former Eleanor Lago. They live in San Jose, CA.

Oct. 9, 1982

# NASA News

National Aeronautics and  
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**Ames Research Center**  
Moffett Field, California 94035  
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Rel. No. 82-41

IMMEDIATE

## Guastafarro Receives AIAA Space Systems Award

Angelo Guastafarro, Deputy Director of NASA's Ames Research Center, Mountain View, CA, has been named to receive the Space Systems Award for 1982 of the American Institute of Aeronautics and Astronautics (AIAA). The AIAA is the principal U.S. professional aerospace engineering organization, and the Space Systems Award is among its leading citations. Selection is made by the AIAA Space Systems Committee of 35 system specialists. The award will be presented in Washington, D.C. on Oct. 19, 1982.

As Ames Deputy Director, Guastafarro has a range of management and technical duties. He has had a long career in space and aerospace project work since receiving his Bachelor's degree in Mechanical Engineering from New Jersey Institute of Technology in 1954. He received an MBA in Research and

Development Management from Florida State University in 1963.

From 1955 to 1963, he served as an officer, and then as a civilian, with the U.S. Air Force Armament Center at Eglin Air Force Base in Florida as an aeronautical project engineer. He began his NASA career at the Langley Research Center, Hampton, VA in September 1963. He served at Langley in a variety of research and development management positions including Scout Mission Operations Manager, Viking GCMS Manager, Viking Deputy Project Manager, Rotor Systems Research Aircraft Project Manager, and the Large Space Systems Technology Program Manager.

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Oct. 9, 1982

# NASA News

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**Ames Research Center**

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Peter Waller

415/965-5091

For Release:

**IMMEDIATE**

NOTE TO EDITORS:

The release date, Tuesday Dec. 14, 2 p.m. on news release #82-45, JUPITER'S MOON EUROPA COULD SUPPORT LIFE IN OCEANS, is incorrect. The correct release date is Monday, Dec. 13, 2 P.M.

# NASA News

National Aeronautics and  
Space Administration

Ames Research Center  
Moffett Field, California 94035  
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For Release.

Peter Waller 415/965-5091

Release No. 82-45

Tuesday, December 14  
2 p.m.

## JUPITER'S MOON EUROPA COULD SUPPORT LIFE IN OCEANS

Researchers have identified a new and surprising place in the solar system which might be capable of sustaining life, if life forms were transplanted there.

The proposed new locale apparently does not have some of the drawbacks for life of various locations on Mars or Jupiter, which could perhaps support life if certain rigorous conditions are met. If the work of scientists Steven Squyres and Ray Reynolds of NASA's Ames Research Center, Mountain View, CA proves out, some low forms of Earth life could be transplanted, and might well survive in the suspected oceans of Jupiter's planet-sized moon, Europa. Squyres and Reynolds presented their findings at

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the American Geophysical Union meeting in San Francisco on December 14, 1982.

Since no one has landed on Europa, the Squyres-Reynolds conclusions are based on spacecraft photographs and other measurements. However, these measurements appear to make a strong case.

A detailed analysis of the data on Europa seems to show that this planetary body has a thick ice surface. Investigators believe the ice covers a liquid ocean which could be 50 kilometers (30 miles) or more deep. This planet-wrapping ocean, in turn, seems to be covered by a skin of ice, like the peel of an orange. This layer of ice may be perhaps five kilometers (three miles) thick, on the average. (Estimates of ocean depth and ice thickness vary by tens of kilometers, but evidence is substantial for deep planet-covering oceans, similar to those on Earth, wrapped in a relatively thin shell of solid ice.) Europa is a planetary body just slightly smaller than the Earth's moon.

As an illustration of the kind of Earth life that exists under conditions something like those proposed for the European ocean, Squyres and Reynolds point to organisms found under the permanent ice of Earth's Antarctic lakes. These organisms get sunlight needed for survival through thick permanent ice, and

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multiply and grow at light levels similar to those calculated for Europa. In both cases, sunlight passes through a permanent ice layer into oceans below.

If life could be supported in the European oceans, it would be thanks to: the heat of radioactive decay in the planet's rocky interior, plus heat from the tidal forces of giant Jupiter's gravity, plus energy from sunlight. The first two energy sources are enough to keep most of Europa's water liquid in the form of a planet-wide ocean. The third (sunlight) would provide enough energy to living organisms for photosynthesis to occur.

Seen in pictures taken during the recent Voyager spacecraft fly by, Europa is perfectly smooth. It looks like a huge, white billiard ball, netted with a pattern of hemisphere-spanning dark lines. The Voyager pictures show that these line features range in width from one kilometer to 70 kilometers (half a mile to 40 miles). Scientists believe these dark lines mark huge, thousand-mile-long fracture zones--the result of continuous cracking of Europa's rigid ice shell due to constantly changing tidal forces. These tidal forces are the result of regular changes in Europa's orbital distance, and hence changes in gravity forces from giant Jupiter. Within these large fracture zones, Reynolds suggests, there are believed to be many relatively small cracks, too small to have been observed by Voyager's cameras.

As cracks form and freeze over, they may provide windows for sunlight to shine through into the ocean waters below--during Europa's 60-hour-long days. Squyres and Reynolds estimate that

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total area of these thin-ice windows could aggregate 25 to 50 square kilometers (10 to 20 square miles) planet-wide, year in and year out. Such ice windows should let in enough sunlight to support known Earth organisms for five to ten years before ice becomes too thick for light passage. This total area of thin ice would provide up to 30 million watts per year of energy useful for photosynthesis in Europa's oceans.

The best evidence for regular cracking of Europa's ice shell is the continuous build-up of new frost--somewhat like snow--on Europa's surface, derived from the liquid water of its ocean.

Other possible energy sources for living organisms in Europa's oceans might be electric currents induced by Jupiter's enormous magnetic field--or heat from volcanic vents in the oceans floor.

Evidence for this picture of Europa is as follows:

The big moon has an average density, which shows that its composition is mostly rock plus about six per cent water.

The heat of radioactive decay plus tidal flexing of the moon by Jupiter's gravity is a highly likely heat source to keep most of Europa's water liquid and maintain its oceans. Without this heat, the planetary body would be mantled in a solid sheet of ice. This would be expected at Europa's cold location, half a billion miles from the Sun. However, even though Europa appears to have an ocean, the surface of this ocean is a shell of ice because it is in direct contact with the freezing vacuum of space--since Europa has no atmosphere.

The planetary body's skin of ice is thought to be relatively

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thin, say Reynolds and Squyres because Europa has an extremely smooth surface--a cue ball. Its surface is so smooth that virtually all craters have smoothed out completely. This indicates a shell of fairly thin ice at a relatively "warm" subsurface temperature.

Internal heat needed to warm up this ice shell is held in by Europa's "insulation blanket." Both Earth satellite and Voyager observations near Europa suggest that it has a unique "fluffy" surface texture. Reynolds and Squyres believe that this is an insulating layer of frost.

Such an insulating blanket would hold in enough heat for an average near-surface temperature of 140 degrees above absolute zero. "Not hot", says Reynolds, but enough heat to smooth out surface craters and other planetary landmarks (found on virtually all solar system bodies) and deform a several-mile-thick ice shell into the smooth sphere observed for Europa.

Further evidence for an insulation layer and relatively thin ice shell for Europa comes from the fact that the planet's trailing hemisphere is lightly coated with sulfur dioxide believed to come from the volcanoes of its neighboring big moon, Io. If Europa were not constantly generating new frost to cover up this sulfur, it would build up and coat the planet thickly in just a few years. This has not happened even over millions of years.

Europa's frost layer builds up further every time its ice shell cracks open exposing liquid water. The water then boils up into the vacuum of space, freezes, and falls on the icy planet's

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surface as frost.

Europa's tides (ice shell-cracking variations in gravity) are caused primarily by Jupiter. Gravity of two other planet-sized moons, Io and Ganymede, constantly "cranks" Europa's orbit into elliptical (oval) form. This means the force of Jupiter's huge gravity varies in strength once each orbit with the regular changes in Europa's distance from Jupiter, resulting from its oval orbit. As Europa is slightly stretched and relaxed with each orbit, it is heated and the ice shell fractured.

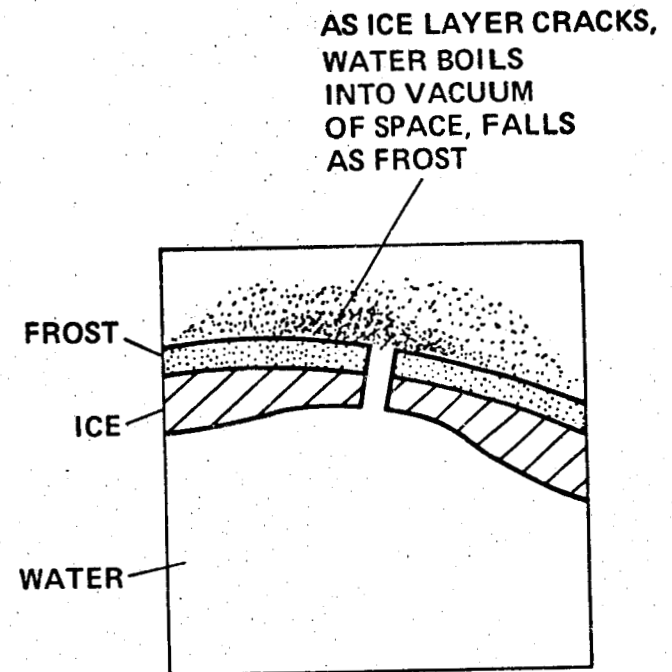
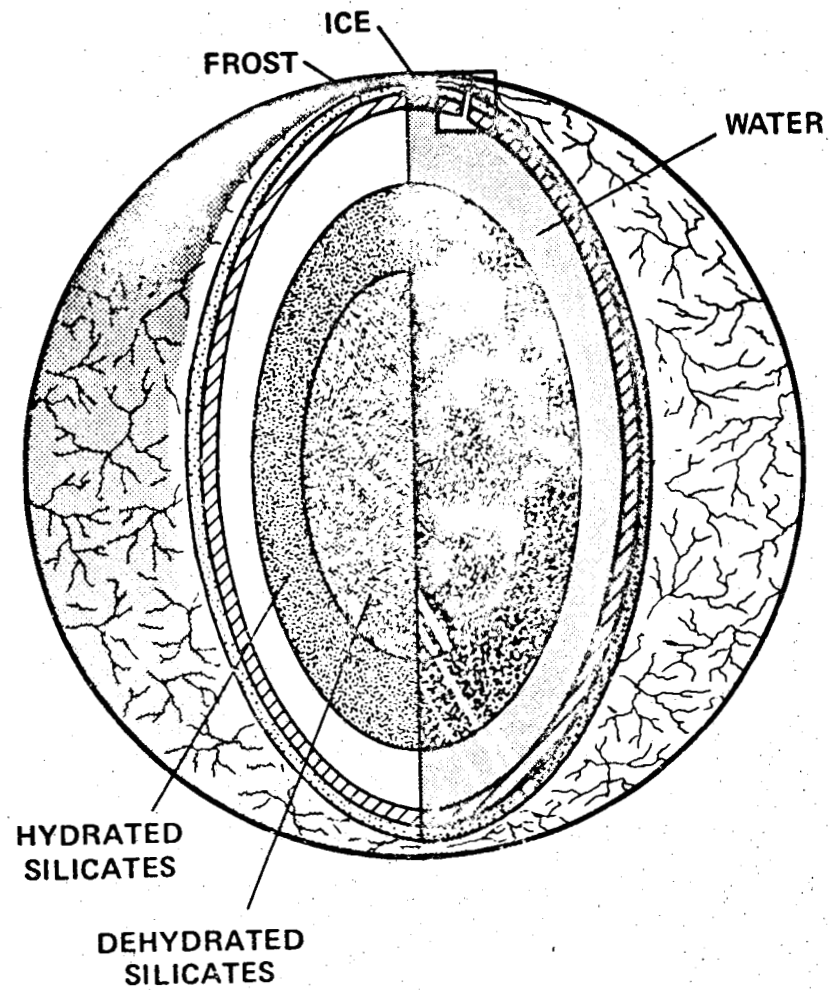
Comment Squyres and Reynolds, the work suggests that Europa could have a relatively small area of life-supporting "oases" in its oceans, an environment very limited in both area and time, which could support life.

(Reynolds was an author of the paper predicting volcanoes on Jupiter's big moon, Io, before the Voyager pictures confirmed their presence.)

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## EUROPAN OCEAN



# NASA News

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Evvie Rasmussen 415-965-5091

For Release

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IMMEDIATE

HAVE ANTENNA -- WILL TRAVEL:

NEW COMMUNICATION SYSTEM OPERATES FROM SUITCASE

Combining a 15-year-old satellite with modern technology, NASA's Ames Research Center and General Electric of Schenectady, N.Y., have developed a remote communications system that fits inside two suitcases and can be carried onboard an airplane.

The remote system consists of a terminal and folding antenna which can be operated from an ordinary AC outlet or from a car battery.

The terminal and antenna can communicate with any of several ground stations using the ATS-3 satellite -- an experimental communications satellite NASA has been operating since 1967.

The system allows an operator anywhere in North or South America and most of the Atlantic or Pacific oceans to communicate at any time with a fixed earth station.

The transportable terminal is contained in two ordinary-sized suitcases that can be carried as luggage in an automobile or on public transportation. One suitcase carries a collapsible antenna, the other an alphanumeric transceiver, the terminal used to send and receive communications. The equipment can be powered

(more)

December 27, 1982

from the cigarette lighter of an automobile or from a 115-volt AC outlet.

The terminal may be operated at any location with an unimpeded view in the direction of the satellite. It takes about two minutes to set up: the antenna is unfolded and directed toward the satellite by reference to a simple chart, compass and elevation indicator.

The operator enters a message on the keyboard, viewing what is typed on a display terminal. After the message is typed, it can be sent to the earth station with one keystroke. With another single keystroke, messages stored at the earth station can be received by the operator. All messages are recorded in print form at the earth station.

Several earth stations, each with its complement of transportable terminals, can operate independently through the satellite. Independent earth stations can also communicate with each other. The alphanumeric communication system does not interfere with voice communications over the satellite, so that a NASA-authorized user can communicate at any time without prior scheduling. The alphanumeric format also offers greater privacy than voice communication.

The ATS-3 satellite has in the past been used to relay voice communications in many disasters and emergencies. During the eruption of Mount Saint Helens in May 1980, an Air Force jeep was used at the disaster site for voice communications via ATS-3, using a General Electric Earth station near Schenectady, N.Y.

The experience at Mount Saint Helens illustrated the need for rapidly deployed long-distance communications that are not

(more)

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dependent on wirelines, because such lines often are destroyed in a disaster and surrounding telephone lines quickly become saturated.

The additional privacy of the alphanumeric system is another attractive element for disaster management -- particularly for search and rescue operations.

The fixed-base station consists of a keyboard, color video display monitor, hard-copy printer, PDP-11 computer, phase-shift keyed modulator and demodulator, radio transmitter-receiver and large aperture antenna. The station takes up about as much space as an office desk, except for its antenna, which must be mounted outside within 100 feet of the radio equipment.

The ATS-3 satellite is maintained at 105 degrees west longitude in an orbital inclination of 9.5 degrees. Its VHF communications transponder is an active frequency, translator-limiting repeater receiving at 149.22 MHz and retransmitting at 135.5 MHz. ATS-3 and its sister satellite ATS-1 are operated by NASA's Goddard Space Flight Center, Greenbelt, Md.

The current NASA-GE operation is a pilot test of the remote system using the ATS satellite. If enough public service and commercial applications are found, the system could be redesigned to operate over satellites other than ATS.

Currently several organizations, including the state of California and the National Association for Search and Rescue, are working with NASA to develop further uses for this technology. The program is managed by the Communications Division, Office of Space Sciences and Applications, NASA Headquarters.

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December 27, 1982